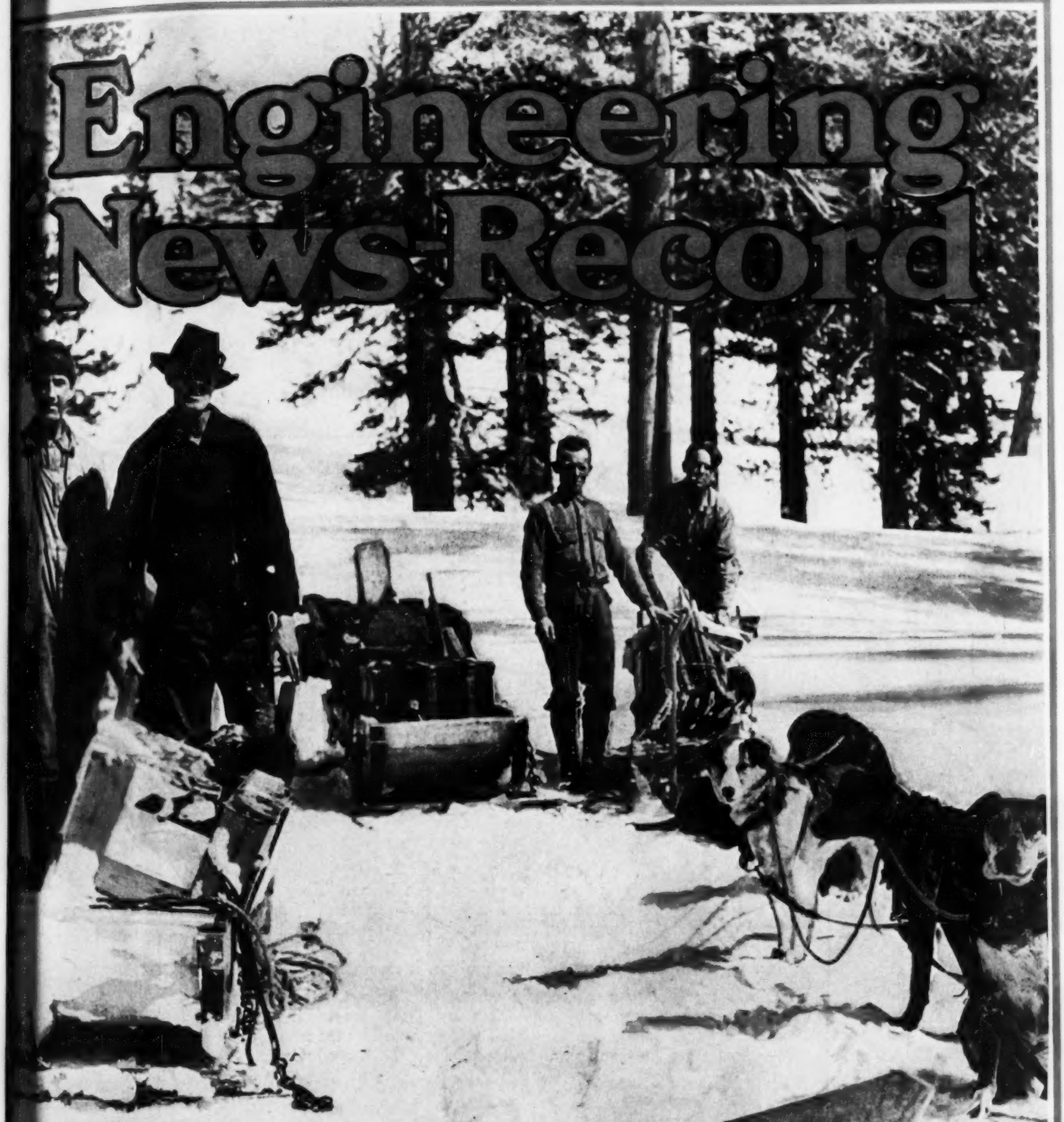
Engineering News-Record



Winter Handling of Freight in the Sierras—Florence Lake Hydro-Electric Tunnel Work

May 3, 1923

McGraw-Hill Company, Inc.

The roof history of every old building is an argument for *permanent roofs*

"FIFTY years old and sound as a dollar"—a typical compliment paid to an old structural landmark that still champions the architecture of 1870.

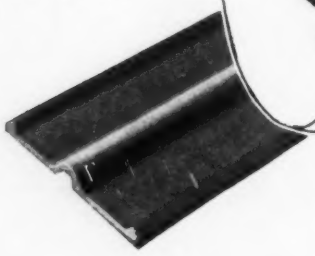
But—how many times during those years has the roof been patched and replaced, how many hundreds of dollars have been dumped into roof maintenance?

Each one of these old structures has taught the construction world the extravagance of putting short-lived roofs on otherwise permanent buildings.

The Rockwood Manufacturing Company of Indianapolis like hundreds of other prominent concerns has accepted this lesson. They built for permanence and, unlike some less enlightened concerns, they did not stop at the roof. Large quantities of Federal Interlocking and Channel Tile were used and as this and hundreds of other Federal installations are proving, their roof maintenance problem is eliminated.

The recognized permanence of concrete, (the only structural material that improves with age) the established excellence of the Federal product, and the fact that it is laid and guaranteed by the manufacturer —these were the considerations that led the Rockwood Company to specify—

made for flat and pitched surfaces



FEDERAL Cement Tile

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

Volume 90 — NEW YORK, MAY 3, 1923 — Number 18

Going Up!

ONCE more the *Engineering News-Record* cost index has gone up. The rise from 213.5 to 216.7 in the month is a fair reflection of the general rise in prices, which has been obvious but not startling. To those who are afraid of a runaway market there is the comfort that the 1923 cost curve looks more like 1918 than 1920 and that so far at least we are not embarked on the steep gradient of rising prices of that wild year. So long as we stick to necessary construction, do not over-order and maintain a self-preservative sense of decency as to prices there is no reason why we cannot keep the curve of construction progress near the desired horizontal.

The Student Chapter as an Honor Society

WHEN the civil engineers at the University of Michigan came to organize a student chapter of the American Society of Civil Engineers a few weeks ago they adopted a novel scheme which will bear watching. In effect they are converting the chapter into an honor society. At Michigan, students in civil engineering are rated on a perfect mark of 4, with a pass mark of 2. As it happens now, an average of all the students marks is 2.3. The new chapter will take in as members only those upper classmen whose rating is 2.6 or above, and on that basis has been organized with 35 seniors and 20 juniors. It remains to be seen how this will work out, but it has the excellent feature of making the society student membership something that has to be worked for, while at the same time the criterion of acceptance is not placed so high as to exclude all but the brilliant student.

Checking Duplicate Orders Difficult

AS WAS to be expected, our comment of last week on the desirability of a non-cancellable or penalty-for-cancellation form of contract for buying building materials has been met by the statement that the manufacturers are taking precautions to see that no more material is ordered for a particular job than that job requires. The objection is not a sound one and whatever inspection is in progress is not sufficient to prevent the over-ordering and duplication evil. So far as we have learned, the non-cancellable or penalty contract affords the only full protection. It is true that the cement companies in particular, acting individually, are trying to check up as to the quantity of cement ordered from them for specific jobs. For work in large cities, this quantity check is possible. It is not feasible, however, on outlying work. Moreover, as to all classes of work, either in cities or in the country, there is no means of ascertaining how many companies have duplicate orders for a given job. The inspection organizations which operated prior to the Hardwood Lumber decision, received information from all of the cement companies so that the duplication as between companies could be prevented. These associations are not now in existence and the amount of checking up that can be done, therefore, by individual manufacturers can stop only part of the over-ordering abuse and none of the duplication. The inspection method of checking abuses, moreover, is economically unsound. It erects an expensive checking system in order to stop the abuses that flow naturally from an unsound practice relative to contracts. The sound procedure is to change the trade practice and adopt a sound contract form which will prevent the abuses from developing. The remedy, in other words, should be sought by prevention and not by repression after the abuse has developed.

Navigable Waters Again

THE time is fast approaching when the Supreme Court must lay down some basic principle on which can be established the exact rights of the federal government in the matter of navigable waters. The question is becoming of paramount interest in the administration of the Federal Water Power Act, especially as regards the collateral question of the jurisdiction of the states, but it is having ever widening implications in other fields. Two instances are at hand, in both of which the federal authorities claim control of an artificial canal as a navigable stream. In the first case, the government attorney submits that the New York State Barge Canal, as a power factor, is a navigable stream and therefore under the jurisdiction of the Federal Power Commission; in the other a similar attorney claims the right for the government to order a railroad to extend and pay for the extension of a bridge to cross the Chesapeake & Delaware Canal, which the government is widening purely for navigation purposes. No navigable water naturally exists at either location. How far can the famous interstate commerce sentence of the Constitution be stretched?

History of Engineering

NOTHING is more fascinating or more elusive than the pursuit of the history of engineering. The vastness and endless detail of the subject and the fact that relatively few engineers leave adequate if any historical data make rare anything more than mere fragments of engineering history. This being so the efforts of the Newcomen Society of England, whose first formal Transactions was noted in our Engineering Literature Section Feb. 15, p. 311, deserve support. Until recently the society had the merest handful of members in this country, presumably because it was young and little known. The membership has increased of late. Doubtless it will grow materially now that its honorary secretary, H. W. Dickinson, has visited this country and met a considerable number of men interested in the history of engineering, as noted in our news section. Among the benefits imparted by adequate history of various branches and elements of the history of engineering and technology the two greatest are help and inspiration—help through the lessons of experience and

inspiration from achievement against great odds. Probably no adequate history of engineering will ever be written, so scanty are the materials of the remote past and even of a half century ago; but in the newer branches, such as airplane and automotive engineering, fuller records are available and most of the makers of such history are still alive. Liberal appropriations for technical research in these newer fields are freely made. Why not appropriations for historical research and record as well? Associations in engineering fields new and old have an opportunity to contribute to the history of engineering that should not be lost. The least of them can well afford to give their support to the Newcomen Society. In so doing they will be fully rewarded, first as is any one who helps a good cause and second by the society's publications. Engineering societies large and small can do far more than this. They can take more pains to make sure that the papers presented before them are of real historical and technical value, instead of being mostly categorical details of matters which at best are of local or personal interest. Some of the technical societies could, through proper committees, provided with modest funds for secretarial and other expenses, do a considerable amount of historical research.

Municipal Home Rule Gains

THE recent passage in New Jersey of an act giving the municipalities of that state the right to decide for themselves whether they will adopt the city manager plan and the adoption by the New York Legislature for the second of the two requisite years of a resolution submitting to the state-wide popular vote a constitutional amendment providing for a considerable measure of municipal home rule are gratifying signs of progress towards a greater but still reasonable degree of municipal freedom. For years past the New Jersey Legislature has smothered or sidetracked proposed legislation permitting its cities and towns to adopt city manager charters. Even now it is only by a lucky last-minute legislative-rush chance that a vote was gained that gave the bill a majority of one in the senate and sent it to the governor. The opposition in New Jersey seems to have come from the politicians generally and from the hosts of commissioners in the many cities where the commission plan, without its frequent manager accompaniment, is in force. These commissioners have larger salaries than will be paid under the manager plan and in addition each commission is the head of an important administrative department—ignorant and inexperienced in city administration as most of the commissioners are when elected. The new law will give New Jersey cities the option of substituting a single trained manager in place of a group of untrained department heads, and will also make that clear-cut separation of legislative and administrative powers that has been considered advisable by most students of government for decades past. The New York home rule amendment, if adopted by the people next November, will free the legislature of a mass of local legislation that consumes time needed for other purposes and affords endless chances for log rolling. Besides that it will give the municipalities of the state the right to settle purely local affairs to suit thir own conceptions of their needs, which they should know better than some scores of men at Albany. Matters of state-wide concern will still remain with the legislature, for control through general laws.

Staking Out the Road to Rehabilitation

JULIUS BARNES, president of the Chamber of Commerce of the United States, has recently returned from Rome with a report of the principles laid down for world reconstruction at the meeting of the International Chamber of Commerce. Those principles are not new. Quite the contrary, they are so fundamental as to be elementary; yet it is heartening to hear them restated so clearly, so authoritatively and so unanimously. And now, with business and industrial sentiment beginning, at least, to rally to their support, there is room for hope that sound business counsel may yet prevail over political opportunism and expediency.

The primary need, all agree, is to restore stability and revive general confidence. What can be accomplished even through this measure alone is indicated by the experience of Austria, where, Mr. Barnes reports, a stabilized currency has inspired industry, stimulated the earning power of the people and revealed a totally unexpected capacity for saving. A revival of general saving and of investment is bound to expand employment and to stimulate production, which alone can raise European standards of living from the depths to which they had fallen. Many, of course, had already reasoned thus far. But the Rome conference was not content with this broad and general statement. It went on to point out how necessary it is to make sure that expansion of employment actually will leave us a net increase in production. For it is only out of net production that standards of living can be raised, and only out of surplus earnings that capital can be made available for further investment and thereby renew the cycle of prosperity.

To this end the conference approved a code of five principles, designed to point the way to maximum production. The first of these calls for "the adoption of every invention and mechanical device that offers economy of production." Herein is a reminder of the unfortunate truth—at once the pride and the despair of the engineer—that inventive and engineering genius has outstripped our administrative capacity, both political and industrial. Despite the forces and appliances that technical science has put at its disposal, mankind has not yet learned how to derive from them the fullest measure of human happiness. The second and third principles demand "the elimination of restrictions on individual output" and "the stimulation of individual effort by payments which reflect the relative individual effectiveness." Here we find embodied the basic principle that, after all, the motive power of industry resides in the individual and will be proportionate to the strength of individual incentive, stimulated by individual reward.

The fourth principle commends "the advantages of private ownership and operation as contrasted with the record made by state ownership and operation" and the fifth advocates "immediate steps to divert men now engaged in non-productive pursuits into productive labor as soon as possible." These conclusions, according to Mr. Barnes, reflect the recent experience of Europe, notably that of Italy and Austria. In Italy, Premier Mussolini—five years ago the foremost Italian socialist editor—has already dropped 40,000 from the rolls of the state railways and now demands that the state divest itself of all those functions that could be discharged by private enterprise. In Austria 100,000 have been

eliminated from the public services and in Great Britain, Mr. Barnes tells us, the return of the railways to private operation has appreciably increased their service to British industry.

The recommendations of the conference as to the specific problems of international finance naturally are designed chiefly to restore stability and to remove unnecessary burdens from the shoulders of those to whom we must look for production. With regard to reparations, the sentiment was unanimous that Germany must acknowledge her liability for wanton aggression and pay to the limit for her resources and earning power; that reparations must carry some security for their payment; and that security against similar aggression in the future must be provided.

It was agreed that in settling allied debts, the ability of debtors to pay should be considered, without subscribing to any doctrine of general cancellation or remission. It was agreed that national finances must show a proper relationship between revenue and expenditure and that taxation for revenue must not be permitted to stifle productive industry. International loans by governments should be discouraged, the conference declared, so that they may be considered on a business rather than a political basis. No confidence was felt in the artificial stabilization of exchange by governments and the opinion prevailed that the goal of exchange should be gold parity through natural processes.

Here, then, are the goals and here are the roads that lead to them. Human necessity is the motive power. It remains to be seen whether human statecraft and the administrative ability command the vision and the skill to fashion a vehicle that will bear the distracted people of Europe out of the economic morass in which they find themselves and into substantial prosperity.

Good Roads and the Financiers

A BOND issue of $100,000,000 is a large obligation for any state to assume. This is the sum which, however, it is proposed that the state of Illinois shall add to its present indebtedness of $60,000,000 for the improvement of public roads. Opposition has developed. The question is raised: How large a paved highway system does the state require immediately? Time of construction it is to be particularly noted is as much the essence of this question as is volume. On one side are the bankers and large financial and commercial interests and on the other are the state administration, the farmers and the town residents. The unusual situation exists, moreover, that the financial and big business interests are opposing and the farmer and rural town taxpayer are proposing the extended expenditure of borrowed money.

Why are the financial interests opposed to a bond issue for road construction in Illinois? There is no doubt that this is the fact. The state administration, as is stated in the staff dispatch in this week's news columns, is advancing the new highway financing plan and the banking and commercial associations are opposing it as organizations. They are conducting their campaign with skill and in force. Again, what is the reason for this concerted action?

Local conditions do not explain it. The strategy of state politics is a factor but not a controlling one. No other local influence stands out. Indeed the action can be explained only by a motive whose influence is general. Is there a banking movement to deflate public credits? There are indications that support such a belief. The volume of non-taxable securities is reaching alarming proportions. Increasing business makes highly desirable a liberal extension of commercial credits. In a score of ways developing conditions urge conservatism in construction undertakings.

On every side there is much to confirm the belief that the bankers' action against extending the borrowing power of Illinois for public road work is a manifestation of general banking policy perhaps in part not yet consciously formulated. If this is a fact then the opposition in Illinois sounds a warning of curtailed credits everywhere for highway improvement.

It is asserted by the bankers that the administration plan cannot be carried out regardless of funds. Their contention that further borrowing is bad financing rests on this argument and on the asserted need of sound economy in public expenditures. The weakness of their argument is that they are not in possession of facts to prove it. In this respect the highway department is at an advantage because it has made some kind of a survey of the construction market. But neither disputant is in a position to assert convincingly that there are or are not and will or will not continue to be, enough contractors, materials, labor and transportation to carry through the enormous program of a thousand miles of paved road construction each year for five or six years.

About the same conclusion seems necessary in the question of how large a paved road system the state requires immediately. The highway department is at an advantage in the argument because all over the country traffic has developed so rapidly that no amount of roadbuilding that a state can find means to do is likely to be too much. However, no one knows and no one can know, without a transportation survey exceeding in scope and detail any which has been made anywhere, whether a 7,800-mile paved road system is required in Illinois or how soon it should be constructed. The situation is no different in any state. Everywhere the planning of state road systems is a process no more certain or definite than a sagacious guess.

The highway situation which has developed in Illinois is of large significance. It introduces new elements into road improvement. One is the critical attention of the money interests. Road development plans have not merely to engage the support of the mass of the people which is uncritical and impulsive, but to sustain the exacting requirements of those who control investments and credits. The second element is traffic knowledge. There is no such knowledge yet although it is beginning to be obtained by research like the Connecticut traffic survey. Economic planning of highway systems requires data on traffic volumes and character and speed, on traffic trends and on its periodic ebb and flow and on transport co-ordination. This research is an essential future phase of highway administration.

An outstanding lesson of the Illinois situation, then, is that traffic knowledge needs to be acquired by highway departments. Until state highway engineers can bring to their support the results of surveys which are more than mere counts of vehicles, they are in an unfavorable position to assert that certain mileages are demanded in a certain time, or to assert what the proportionate mileages of paved or unpaved roads should be.

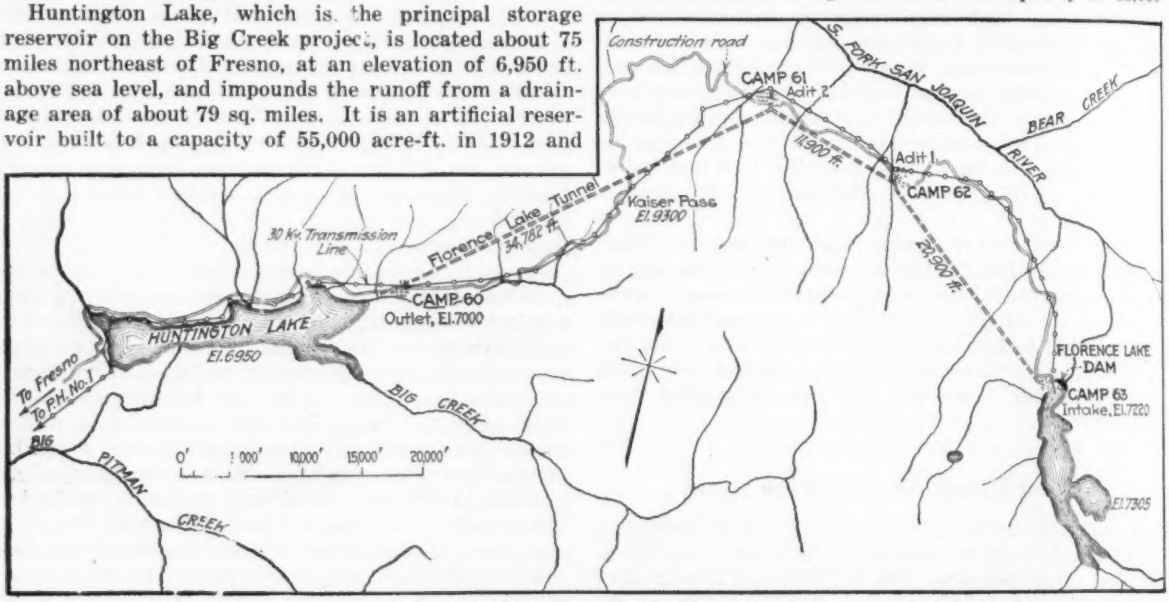
Methods and Progress in Constructing the 13-Mile Florence Lake Tunnel in California

New Tunnel Will Drain 320-Sq. Mile Area Into Huntington Lake Whence a 4,719-Ft. Drop Is Utilized by Chain of Hydro-Electric Plants—Location Is Longer But Can Be Built Quicker Than Direct Route

By D. H. Redinger
Resident Engineer, Southern California Edison Co., Cascada, Calif.

Rapid increase in population and in the industrial and agricultural activities of Central and Southern California during recent years has trebled the power demand in the area served by the Southern California Edison Co. Every effort has been made to increase plant capacity to meet these demands and increases in the installed capacity of all of the power houses on the Big Creek project have been planned, together with the construction of additional plants at points where more power can be developed.

Huntington Lake, which is the principal storage reservoir on the Big Creek project, is located about 75 miles northeast of Fresno, at an elevation of 6,950 ft. above sea level, and impounds the runoff from a drainage area of about 79 sq. miles. It is an artificial reservoir built to a capacity of 55,000 acre-ft. in 1912 and 1913; the three dams which retain the waters of the lake were raised in 1917, making its present capacity 88,000 acre-ft.



MAP SHOWING RELATIVE LOCATION OF THE TUNNEL AND THE TWO RESERVOIRS

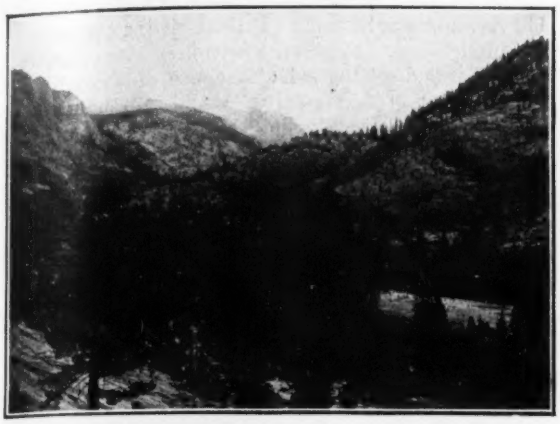
Three powerhouses, No. 1, No. 2 and No. 8, with a combined capacity of 140,000 hp., now utilize the water from Huntington Lake through a total fall of 4,719 ft. Powerhouse No. 3 is under construction, scheduled for operation in the early fall of 1923, with 100,000 hp. A third generating unit rated at 22,000 hp. is being installed in powerhouse No. 1, making a total additional plant capacity of 122,000 hp. being installed during the present year, which will be supplied by the Huntington Lake reservoir.

The ultimate plans for the development of all of the power available on the streams below using water drawn from Huntington Lake call for slightly more than 1,000,000 hp. To make possible the development of this amount of power it was necessary to increase the drainage area supplying Huntington Lake, by tunneling into another drainage basin.

Early in 1920 plans were completed for tunneling Kaiser Ridge, which lies to the northeast of the lake, and thus tapping the upper reaches of the south fork of the San Joaquin River. Kaiser Ridge, with a crest elevation of 10,000 ft. above sea level, separates the Huntington Lake Basin from the area drained by the San Joaquin River.

It is about 11 miles in a straight line from Huntington Lake to a point on the south fork of the San Joaquin whence water can be diverted to the lake by gravity. At that point on the river a dam 120 ft. high is to be built to form a storage basin with a capacity of 43,000 acre-ft. This new reservoir will be supplied by a drainage area of about 320 sq. miles, extending eastward to the high altitudes of the Sierra Nevadas, where snow lies for almost the entire year. A small natural lake, called Florence Lake, which will be submerged by the new dam, gives the new tunnel its name.

Rather than attempt to drive a straight tunnel 11 miles long, which could be worked from the two portals only, it was decided to locate the tunnel parallel to the river for about 7 miles from the intake and at this point turn southwesterly for a 6½-mile tangent under Kaiser Ridge to Huntington Lake. Although this plan increases the tunnel length by about 2½ miles, the additional length is more than offset by the advantage of having two adits which tap the tunnel on the northerly slope of Kaiser Ridge, cutting the tunnel into three sections, the longest of which is 6½ miles. By constructing the tunnel in three sections, six working headings are made available, cutting down the construction period to that required to drive the longest tangent. It is estimated that it would take approximately two years longer to construct the tunnel in one tangent,



SITE OF FLORENCE LAKE RESERVOIR, EL. 7,200 FT.

which would not be economical from a construction standpoint and would not meet the requirements of the power market served.

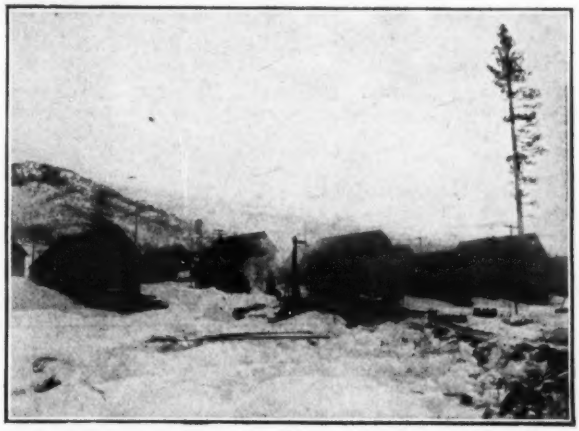
Actual construction was started in 1920, and it is planned to have the tunnel in operation by the Spring of 1926. The total cost will be approximately $16,000,000.

When work on this tunnel was begun the country between Florence and Huntington Lakes was covered with virgin forest, with no means of communication other than steep mountain trails. Camp 60 was established at the outlet portal at the eastern end of Huntington Lake in July, 1920, and at the same time work was started on the road to climb from Huntington Lake through Kaiser Pass, El. 9,300 ft., and thence down the northerly slope to the site of the adit at Camp 61.

Road work was carried on from five camps, and within about two months 11½ miles of good dirt road had been completed connecting Camp 60 at the outlet portal with Camp 61. Here a permanent camp was established for carrying on the tunnel work during that winter. At this elevation there are seldom more than five months during the year when snow does not lie on the ground in depths ranging up to 10 ft. By Oct. 1 a permanent winter camp (Camp 60) was completed at the outlet portal and an open cut begun at that end of the long tunnel tangent. On Oct. 15 the first set of timbers was placed and underground work was begun. By the middle of November Camp 61 was completed and ready for the winter's work, and an open cut was commenced in sand at the adit's portal. Thus it was possible to continue work at both ends of the long tangent during the winter of 1920-21.

ROAD WORK NEAR KAISER PASS, EL. 10,000 FT.

Excavation carried on from both these camps was at first slow and difficult and required heavy timbering. At the adit at Camp 61 soft running sand was encountered, and at the outlet portal the rock was wet, decomposed granite, sand and boulders. By April 15, 1921, 395 lineal ft. had been driven at the outlet heading and 306 lineal ft. in the adit at Camp 61. Various methods of attack were employed at both headings, but the work was chiefly confined to hand labor in small timbered drifts with breast boards and a large amount of piling to hold back the flowing sand and caving ground. Mucking was done with Shuveloders, and tramming with storage battery electric locomotives hauling between four and six 1-cu.yd. dump cars. For the purpose of double tracking the adit was made the full size of the tunnel cross-section, which is 15 ft. wide with a central height of 15 ft., the bottom being square and the roof arched on a 10.8-ft. radius. This section, unlined except in the portions where soft material is encountered, is calculated to give a flow of 1,000 sec.-ft. on the grade of 3 ft. per M.



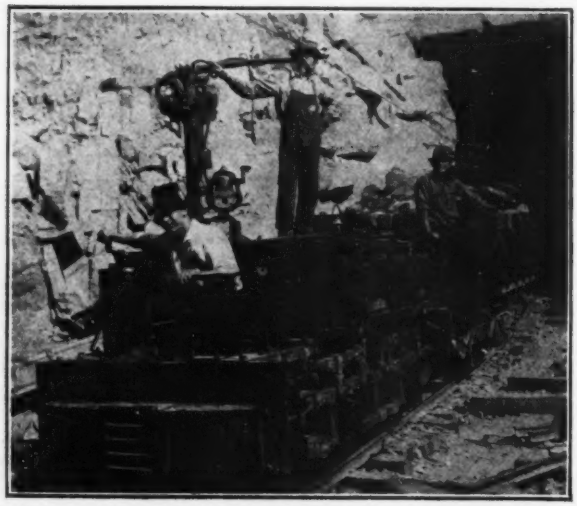
RADIO STATION AT CAMP 63, ONLY MEANS OF COMMUNICATION

After six months of continued effort the adit at Camp 61 was less than one-third completed and, of course, no excavation had been made in the tunnel. It was then decided that some means of speeding up the work was imperative and a 45-deg. incline shaft into the main tunnel line west of the adit was sunk. This incline was located 1,655 ft. toward the outlet portal from the point of intersection of adit and tunnel. It was begun on April 15, 1921, and after traversing 247 ft. in hard granite was completed down to tunnel grade on July 23. From the bottom of this incline the tunnel was driven toward the outlet portal by ordinary hard-rock methods, using the heading-and-bench system. Very good progress was made in spite of the handicap of having to remove all material by a skip operating by an air hoist at the head of the incline.

Due to the slow progress on account of the sand in the adit extending from the portal to a point about 800 ft. in, a 13 x 22-ft. vertical shaft was sunk to the adit grade. The shaft was about 87 ft. deep and was located in the adit about 170 ft. from the point of tunnel intersection, where rock outcrop on the surface indicated

solid material. This shaft was started June 25, 1921, and was completed to tunnel grade in 49 days. This made two more headings possible, one along the adit so as to attack the sand from both ends, and the other heading along the adit towards the tunnel.

On Dec. 17, 1921, the small pioneer drifts in the adit holed through and two months later the adit excavation was completed, allowing muck trains to be hauled out through the adit. Mucking through the vertical shaft was then discontinued. On April 6, 1922, the 1,600-ft. section of tunnel which was started west from the vertical shaft broke through at the bottom of the incline shaft. By that time the heading going west from the bottom of the incline had been advanced 1,300 ft., bringing the total progress at Camp 61 up to 2,900 lineal ft. of tunnel and 1,086 ft. of adit. At the outlet portal the heading being driven east advanced 2,925 lineal ft. during the same period.



ELECTRIC LOCOMOTIVE WITH 4-CU.YD. DUMP CAR
On this job combination locomotives are used arranged for operation either by storage battery or trolley. Ordinarily much is hauled out in 5-car trains.

With mucking through the vertical and incline shaft at Camp 61 no longer necessary, attention was concentrated on a single heading going west from the adit. With a better organization and more uniform rock, as well as improvements in equipment, better progress was made from that time on. For the first six weeks in 1923 this heading was advanced an average of 83 ft. per week. In the same period at Camp 60 the average heading progress was 112 ft. per week.

At both headings the heading-and-bench method with drills on both horizontal and vertical bars is being used. The horizontal bar is used when the bench is being drilled and two vertical columns are used for drilling the top heading. The depth of holes in the top heading varies from 10 to 14 ft., and the total number usually about 40.

Three 8-hour shifts are found to be the most satisfactory arrangement, particularly since the 8-hour law limits work underground to 8 hours. It is not the easiest kind of an arrangement to schedule, because one crew cannot get the holes completed before their 8-hour shift period is up and the result is that two crews have to work on the same round of holes. This is rather unsatisfactory; it would be simpler and speedier to have each shift complete the round which it started.

Because the Florance Lake tunnel is a long and costly job, it was thought worth while to fit the equipment to the tunnel size. Beginning with the cross-section of the tunnel and setting aside that part of it required for the operation of an air-driven steam shovel, dump cars were built of the maximum size that could be operated in the remaining available space. Their height had to be kept down in order that they could be loaded through the bottom of the steam shovel dippers. The special cars built have 14-in. wheels and are about 4½ ft. high. Several improvements that were factors in increasing progress may be cited as follows:

(1) Supplanting of the smaller capacity Shuveloders in August, 1921, with a special type No. 25 Marion steam shovel operated on compressed air. The special features of these shovels are chiefly minor changes in standard design that enable the equipment to work effectively in a 15 x 15-ft. tunnel. The time required for mucking was greatly reduced when these shovels were put into operation.

(2) The substitution of dump cars with a capacity of 4 to 6 cu.yd. for the 1-cu.yd. dump cars and also the improvement of trackage facilities. At the present time trains of five cars, carrying about 20 cu.yd. per train, are being handled. These larger dump cars were not practicable until the air-operated shovels were brought to the job.

(3) Supplanting the storage battery locomotives with combination storage battery and trolley type locomotives, permitting trolley operation to within about 800 or 1,000 ft. of the heading. This made it possible to haul heavier trains and enabled locomotives to go wherever the track is clear, without flexible leads or trolley wires, which are subject to destruction by flying rock fragments. The locomotives are Baldwin-Westinghouse 8-ton machines, and in addition to the regular trolley are equipped with Hobbs 17-plate storage batteries rated at 220 ampere-hours and 275 volts, the same as the trolley voltage.

(4) Replacing the 12-in. steel ventilating pipe with 24-in. wood stave pipe, and installing larger blowers, which clear the tunnel of gas after blasting in less time. The wood stave pipe was chosen for two reasons; with the wood pipe there is no danger of collapse from concussion and when a heavy rock fragment falls on the wood pipe the result is only a hole broken through over which a patch can readily be placed, whereas in steel pipe any fragments crush the pipe and repair requires renewal of the section. Of course, very large rock would put either out of commission. The 24-in. wood stave blower pipe is now suspended from the center of the roof in order to give more room along the sides of the tunnel.

At present the blowers are supplying air to the headings 6,500 ft. distant, but some time in the summer of 1923 it is expected that larger-capacity blowers will be installed. Several No. 3 Root type blowers are in use. At Camp 60 a No. 6 Root blower is used. Camps 62 and 63 at the upper adit and intake portal are to be equipped with No. 11 American blowers, the latter with a rated capacity of 9,000 ft. of fresh air per minute at a distance of 5,000 ft. under 2-lb per sq.in. pressure.

At the outlet portal 900 ft. of the tunnel had to be timbered before reaching rock solid enough to be self-supporting. In the adit at Camp 61 sand and boulders and some quicksand were encountered, requiring timbering for 600 ft. In the main tunnel at Camp 61 about

FREIGHT IN WINTER IS HANDLED BY DOG TEAMS

500 ft. has been timbered to date, due to bad seams and blocky granite. From indications thus far it is estimated that perhaps about 2 per cent of the total length of the tunnel will require concreting. The 800 ft. in soft material at the outlet portal has already been lined with concrete, using the pneumatic concrete gun, a minimum thickness of 12 in. being placed.

A sawmill with a capacity of 1,000,000 ft. b.m. per month is in operation at Camp 61, where all lumber used on the east side of Kaiser Pass, including tunnel timbers, has been cut. During the summer of 1922 the construction road was continued to Florence Lake, and by late fall Camps 62 and 63 had been established and were well stocked with supplies, equipment and materials for their eight months of winter isolation. Supplies for an eight-month period for these three camps total about 15,000 tons, all of which went in via motor truck over the construction road through Kaiser Pass during the open season. Work underground has progressed favorably through the winter. Up to Feb. 17, 1923, at Camp 63 with 200 men working one shift there was 339 ft. of tunnel excavated. At Camp 62 with 217 men, working three shifts in the tunnel since Aug. 9, there was excavated 830 ft., which is the total length of the adit and 468 ft. of the tunnel, working toward the intake.

A 30,000-volt transmission line was built from Cascada, the nearest power house, to the several tunnel camps early in the construction program, and thus far this power line has been kept in service through the winter with only occasional interruptions of short duration. A telephone line through this rough country was considered too uncertain, particularly for the emergencies of winter service to such remotely situated camps, and radio communication is therefore used exclusively. A radio transmitting and receiving station in each camp, and at construction headquarters at Cascada, is open for twenty-four-hour service. The radio installations were described in *Engineering News-Record* July 14, 1921, p. 57.

As a means of "keeping the men happy" on the isolated work, each camp is provided with a recreation hall and reading room equipped with phonograph, pool table, magazines, etc., and once a week a moving picture is shown twice, the hours being arranged so that all shifts have an opportunity to see it.

According to the present schedule the tunnel tangent between the intake and adit 1 and the tangent between adit 2 and the outlet should be completed in the fall of 1925. Work on the 2¼-mile section between adit 1 and adit 2 will be started in ample time to be completed by the time the two longer sections are finished. This will make the tunnel available for conveying the 1926 runoff which will be diverted into the tunnel for the first year or two by a low timber crib diversion dam.

Imhoff Tank and Sprinkling Filter Studies at Plainfield Works

Joint Investigations of New Jersey Agricultural Experiment Station and New Jersey State Board of Health

By Dr. William Rudolfs
Chief, Sewage Investigations, Agricultural Experiment Station, New Brunswick, N. J.

Abstract of a paper read before the New Jersey Sewage-Works Association.

THE WORK in the sewage substation of the New Jersey Agricultural Experiment Station and the New Jersey State Department of Health was begun about a year and a half ago with the study of chemical changes occurring in the sewage filtration plant at Plainfield, N. J. Dr. R. O. Smith, then chemist in charge, started work with the sprinkling filters in the hope that chemical analysis would produce sufficient evidence for a more detailed study of the plant. Alongside, quantitative determinations were made of the fauna (protozoan, annelids, etc.) occurring in the filter. A part-time botanist was employed to determine the species of fungi and algae adhering to the stones. In October, 1922, the interdependence of the flora and fauna was recognized, and a chemist, bacteriologist, zoologist and botanist were employed to carry on the different lines of study.

Our interest in the sewage flora and fauna is a very practical one. We want to find out: (1) what organisms are present in sufficient numbers to carry on the digestion processes, and (2) how these organisms accomplish purification. This work necessarily calls for a study of the organisms present and of the chemical changes involved.

Imhoff Tank—Although the studies of the botanist have not gone very far, we know that but very few fungi and algae are found in the Imhoff tank. Unfrequently masses of filamentous bacteria occur in the scum, and we do not know as yet whether these slimy organisms are colonies of bacteria attacking gelatine material, or whether they are a special kind of fungi.

We have some interesting information about the protozoa occurring in the Imhoff tank. Table I gives an idea of the distribution at different depths of protozoa. It is quite apparent that with increasing depth the numbers of animals increase. As a rule, the scum formed in the vents of the tank does not contain protozoa at all. It is interesting to note that the numbers of flagellates in the influent are ordinarily the same as the numbers in the effluent. The same is the case with ciliates.

TABLE I—FLAGELLATES AND CILIATES IN THE IMHOFF TANK
(Individuals per c.c.)

Depth in Feet	Flagellates	Ciliates
0	0	0
2	5	2
5	80	20
7	150	90
10	600	200
15	900	400
20	1,200	800

In the Imhoff influent and effluent the flagellates number usually about 75 c.c. and the ciliates 20.

Table II shows the relative numbers of bacteria representing the proteolytic activities and also nitrogen transformation. Liquefaction of proteins is that change by which

solid and insoluble organic material is converted into a soluble condition, furnishing thereby a food supply for bacteria which are producing ammonia, hydrogen sulphide and those which attack albumen. The reduction of sulphates, which are usually present in sewage, together with the sulphur from the proteins, give rise to the production of sulphuretted hydrogen.

The value of bacteria presented in Table II represents averages of from 18 to 24 samples. To obtain the value of bacteria in one sample it was necessary to prepare seven dilutions ranging from the concentrated material into the various groups. Eleven different media were used. Each medium was then inoculated with the dilutions just mentioned.

TABLE II—RELATIVE PREVALENCE OF PRINCIPAL GROUPS OF BACTERIA IN AN IMHOFF TANK

Type of Organisms	Organism per c.c.	
Proteolytic		
Digestion of peptone with NH_3 production	1,000,000	
Digestion of gelatine with liquefaction	700,000	
Digestion of peptone with H_2S production	350,000	
Digestion of coagulated albumen with liquefaction	200,000	
Reducers of nitrogeneous compounds		
(a) From nitrate to nitrite	200,000	
(b) From nitrate to nitrogen gas	100,000	
(c) From nitrate to ammonia	250,000	
Total denitrifiers		650,000
Oxidizers of nitrogenous compounds		
(a) From ammonium salts to nitrite	200,000	
(b) From nitrite to nitrate	250,000	
Total nitrifiers		450,000

From the table it can be seen that the more abundant bacteria are those which attack the most easily digested protein material, like bacteria which attack soluble protein with the production of ammonia. These bacteria were always present even in the highest dilutions used. There is no doubt that bacterial numbers bear some relation to the character of the protein molecule. This seems to be shown by the fact that bacteria which produce sulphides from soluble proteins are less prevalent than bacteria which produce ammonia from the same substances.

Another interesting feature brought out in this table is the oxidation of nitrogen. The nitrogen is oxidized to the nitrate stage, still at the same time organisms are present which reduce nitrate nitrogen to nitrite nitrogen and finally to ammonia. In the Imhoff tank this latter group is in ascendance. In addition to the groups of bacteria mentioned, other organisms have also been found, namely: (1) Bacteria producing sulphides from inorganic sulphates. (2) Bacteria oxidizing thio-sulphate to free sulphur and sulphates. (3) Bacteria which digest cellulose. (4) Bacteria which split fats. The bacteria producing sulphates might be of importance since the sulphates exert influence upon all reactions involved in the tank. If the sulphate organisms become numerous, acidity in the tank increases and the activities of other groups of organisms might be partially or totally inhibited. On the other hand, when no sulphates are formed a tank becomes too alkaline and phenomena familiar to the sewage operator, like foaming, etc., occur. The bacteria which split fats have considerable importance for the digestion of the scum formed on top in the tank. The fermentation of cellulose gives rise to the production of gases. For that reason it is very important that gas determinations be made.

Besides chemical analysis of the Imhoff influent, the scum, the liquid layer between scum and partially digested sludge, etc., we are also determining the exact acidity and alkalinity of these materials. We find that in nearly every case the scum is decidedly less alkaline than the influent and in nearly all cases less alkaline than the preliminary sludge. The scum ranges from pH 6.8 to 7.6, while the influent changes but little, namely from pH 7.5 to 7.8. As far as we are able to determine at present the tanks are working better when the effluent is slightly more alkaline than the influent.

Bacterial action causes considerable production of carbon dioxide, which gas is partially dissolved in the water forming carbonic acid. At the same time the sulphur organisms producing H_2S, and the sulphates present or produced by bacteria, cause a reduction of alkalinity of the material. This explains why we usually find that the liquid layer is slightly less alkaline, or some times neutral, as compared with the influent. The foaming which a practical operator observes, has no doubt connection with the amount of gas produced.

The foaming might be caused, as has been pointed out above, by certain chemical reactions and by the production of large amounts of gases. Therefore, organisms producing large quantities of gas, although they are beneficial in small quantities, can be the cause for the poor operation of a tank. For that reason it is very important that the relative numbers of the different groups of bacteria remain constant.

Our chemist is engaged in making periodical gas analyses. Some typical examples of such analyses are presented to show the relative abundance of the gases. These samples are taken in successive weeks from the same tank, which was in operation during this time, and from the same compartment of this tank.

	CO_2	CH_4	N_2
Feb. 24	29.4	65.7	4.9
March 3	32.6	64.6	2.8
March 10	31.4	65.4	3.2

It is very interesting to note the total absence of oxygen and hydrogen. Analyses by other investigators usually show a little oxygen and hydrogen. Our samples were taken with unusual care into glass stoppered containers so that no atmospheric gases could penetrate. The tank from which these samples were taken was a fair working tank, although on the verge of foaming. At the time the sample of March 3 was taken, the weather was fairly warm and this might account for the rise in CO_2 production. The two other samples were taken at days when a rather low temperature was prevailing.

Sprinkling Filters—Samples were taken from the surface sprinklers, also at depths of 1, 2 and 3 ft. in the beds, and from the effluent. The slimy film which accumlates on the stones of sprinkling filter beds is known to play a very important rôle in the purification of the sewage which passes through the filter. This film is composed largely of a host of bacteria, a great variety of microscopic animals and occasionally an abundance of fungi. During the greater part of the year, the biological activities within this film are such that the sewage passing over it is sufficiently purified, however, there are periods of the year when the film does not act properly, and the purification is not as good as is produced at other times. This undesirable condition of the filter bed is usually associated with a very heavy film on the stones which finally breaks up and passes through the bed as suspended matter. Our investigations showed that considerable amounts of fungi are associated with these heavy films.

The film on the surface is characterized by the great predominance of algae. The algae are not present in great variety but are extremely abundant in quantity. At all points where the spray from the nozzles falls directly on the stones, the surface is covered with a bright green algae growth. Very near the nozzle and again all around the region of heavy spray fall, there are zones of brown to grayish brown or greenish brown. The green zone consists almost entirely of a well branched filamentous green algae of the Stigeoclonium species. Associated with the green filamentous algae are always a large amount of one-celled green algae of the Protococcus type. The brown film of the inner and outer zones is composed almost entirely of the blue green algae, Oscillatoria. Fungi were never found in great abundance on the surface.

Around the stones within the filter bed itself almost no algae are found but the film contains large quantities of fungi. There is no marked difference in the kind or amount of fungi present at the different levels of the filter bed. The seasonable fluctuations upon the fungi seem to be quite important. During March, April and the first part of May fungi became very abundant, the maximum being reached about the last of March. This was just before the spring slough took place. The same was noted again in the fall during the sloughing period.

When fungi are abundant, it is quite obvious that they act as a network in holding the film together. However, fungi are not the only apparent binders. As the fungi disappear (after the sloughing) there are increasing amounts of filamentous bacteria and of protozoa (Opercularia) which help to hold the film together. A branched filamentous zoogleal bacterial mass also becomes an important binder. During this time stalked protozoa helped considerably in building up the film. Living in this film, in addition to bacteria and fungi, are protozoans, nematodes, annelid worms and arthropods. Exact acquaintance with these organisms is necessary for an understanding of the operations of the film, and may conceivably be of use in its control. It must be emphasized, however, that it is the living

TABLE III—OPERCULARIA AND NEMATODES IN FILTER BED THROUGHOUT THE YEAR

(Individuals per c.c.)

Months	Opercularia	Nematodes
July	65,000	70,000
Aug.	33,000	71,000
Sept.	70,000	70,000
Oct.	170,000	60,000
Nov.	235,000	60,000
Dec.	100,000	60,000
Jan.	72,000	72,000
Feb.	80,000	100,000
Mar.	100,000	76,000
Apr.	235,000	60,000
May	350,000	50,000
June	150,000	72 000

aggregate of associated organisms constituting the film, rather than any simple type of creature which is significant for purification of the sewage. Although certain types of chemical activity may be correlated directly with the occurrence of particular sorts of protozoans we cannot conclude that these types are responsible for the chemical changes, but when we study the different groups of organisms and certain specific changes occur we can fairly well predict what changes will take place. It is extremely interesting in this respect to see (Table III) that during and shortly after the sloughing periods the protozoans are disappearing.

Nitration as shown by Table IV increases rapidly after the slough and when the film around the stones becomes thicker nitration decreases.

With the disappearance of Opercularia in the natural film nitrification becomes better. This might be caused by the fact that after their disappearance an abundant food supply is left for the bacteria. We found that these protozoans eat large quantities of bacteria and these known factors together might count for the increase of a more stable effluent. The numbers of nematodes are fairly constant throughout

TABLE IV—NITRATION IN SPRINKLING FILTERS DURING AND AFTER A FALL SLOUGHING PERIOD

(Parts per Million)

Date	Surface	Effluent
Oct. 10	0.18	3.7
Oct. 17	0.07	4.2
Oct. 23	0.07	5.65
Oct. 27	0.26	5.35
Nov. 6	0.01	8.6
Nov. 14	1.0	5.2
Nov. 27	0.50	7.8
Dec. 4	0.30	7.1
Dec. 11	0.20	7.4
Jan. 2	1.8	4.9

the year. The moving about of the nematodes in the film serves to make it more porous and probably also aids in loosening the film and thereby accelerating the slough.

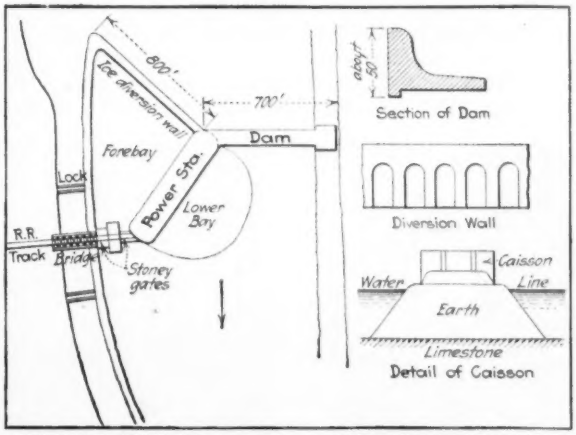
The bacterial work on the filter beds is not sufficiently advanced to permit the drawing of conclusions.

Dehydration Studies in sludge by means of chemicals (alum and sulphuric acid) have been carried on both in the laboratory and field. The practical application was tried during December but owing to the heavy snowfall no definite conclusions can be presented. The experiments will be repeated as soon as the weather opens up. We are reasonably sure, however, that the drying time can be materially reduced.

Hydro-Electric Plant Near Petrograd

CONSTRUCTION of an 80,000-hp. hydro-electric plant 80 miles east of Petrograd, on the Volchov River (spelled Wolko on most maps) is well under way, writes Max Kadinsky, a young Russian engineer who is a graduate of the University of Illinois and formerly worked for consulting engineers in Chicago on grain elevators. Part of his letter is as follows:

Here on the River Volchov is under construction a hydro-electric power station with a head of about 40 ft. It will have eight vertical type turbines of 10,000-hp. capacity each, which it is estimated will have an average yearly output of power of 40,000 hp. It is to be delivered to Petrograd, a distance of about 120 versts (verst = ⅔ mile), at 110,000 volts. There is also under construction a canal to make the Volchov navigable. The canal will be about



VOLCHOV (RUSSIA) 80,000-HP. HYDRO-ELECTRIC PLANT
Foundations built under compressed air because of a porous limestone ledge and to speed up work. Gas engines of total 1,400-hp. capacity used for constructing power plant.

1 verst long. The power station will consist of a masonry spillway dam, an ice diversion wall and a reinforced-concrete building housing the electrical units.

The foundation for the power house, dam and ice diversion wall is being carried on by the use of compressed air caissons. One reason for the use of this method is because it is the quickest and the surest way of getting the job done under the present conditions. The second reason is that the bottom of the river consists of a limestone ledge with porous layers so that the use of the open cofferdam method would be extremely difficult. The portion indicated as the power house in the sketch is to have reinforced-concrete caissons built on soil especially formed for them.

So far we have about one-third of the earthwork for the canal done, four caissons for the power house have been sunk and we are now ready (Jan. 30) for sinking almost all of the others for the power station and for the ice diversion wall. In order to get this work accomplished quickly, a town of wooden frame buildings was constructed around the works for housing the workers. Material storage, powder magazines and a dining house, club, bath house, fire department and a school have been provided.

To supply the works with the required energy a power house with gasoline engine delivering 800 hp. has been set up. A similar one is under way to give 600 hp. and a third steam power plant will be completed in the spring furnishing 500 hp. In addition, we have two plants for compressed air having a capacity sufficient to sink five of the large reinforced-concrete caissons 18 x 100 ft. in plan and 13 ft. high.

Mr. Kadinsky states that he occupies the modest position of head of the sub-department of technical statistics. He registers all of the facts dealing with the labor, materials, economics of work and similar things.

Timber Treating Plant Operates Different Processes

Creosote or Zinc for Ties and Timbers—Tie Yard and Tracks—Cylinders Rest on Slides and Have Exterior Heaters—Site Convenient to Large Timber Tracts—Many Roads Served

INCREASING demand for treated ties, piles, poles and bridge timbers in railway work has led to the construction of a new wood-preserving plant at Louisville, Ky., by the Producers Wood Preserving Co., which has been organized for this purpose by the Ayer & Lord Tie Co., Chicago, and Bond Brothers, Louisville. Both of these firms are producers of ties and timber, so that the plant will be operated mainly as a part of their general timber business. Some railroads are sending their own ties to be seasoned and treated at this plant, but others purchase ties from the company. In either case the treatment is carried out according to the specifications of the individual railroads, for which reason the plant is designed for operation with creosote-

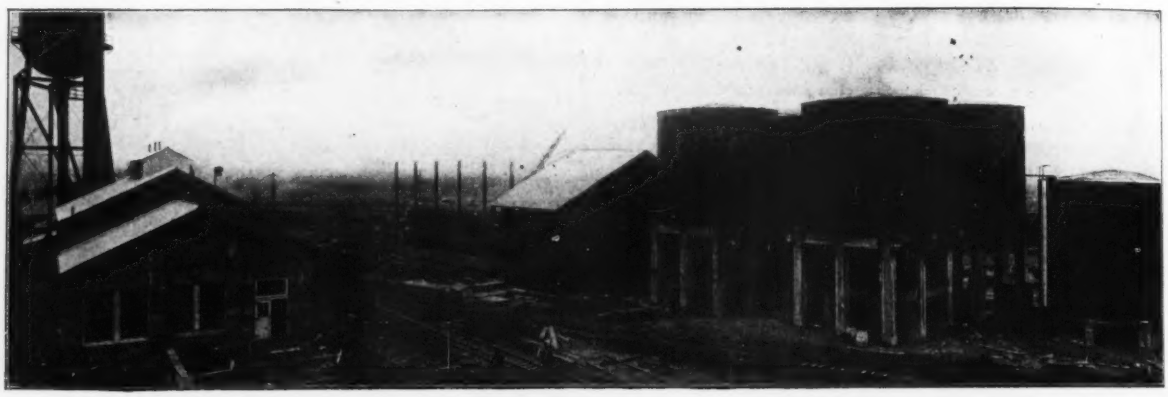


FIG. 1—TIE AND TIMBER TREATING PLANT AT LOUISVILLE, KY.
Cylinder house (uncompleted) and pump house in center. Four working tanks on concrete towers and zinc solution tank at right. Power house with stack and elevated tank at left.

oil or zinc-chloride and with a variety of modifications in either process. The treating capacity is from 4,000 to 5,000 ties per 12-hour day. A general view of the plant is given in Fig. 1.

The selection of Louisville as the location of the plant was made with a view to serving a large number of railroads in the central and eastern states, since this is a convenient point for both the collection and distribution of timber. Oak, pine and beech will be the principal woods treated. The site is about 4½ miles from the city, in open country where there is ample room for expansion. Good drainage is assured as the land is 8 ft. above the maximum flood level of the Ohio River. Railway service is provided by branches from the Kentucky & Indiana Terminal Ry. and the Illinois Central R.R. An area of 150 acres provides ample space for the storage and seasoning of about 1,500,000 ties for treatment. Little or no storage space is required for treated ties, as these are usually loaded directly from the tie trams into cars for shipment to the owners. In general the seasoning period is nine months. The layout of the yard and plant is shown in Fig. 2 and that of the plant is shown also on a larger scale in Fig. 3.

Tie Yard—In the storage yard all tracks have three rails to accommodate standard gage railroad cars and 36-in. gage tie trams, so that ties can be unloaded and stacked directly from the cars and loaded directly from the stacks into trams for delivery to the treating plant. Rails of 70-lb. per yard are used for the standard gage, three-rail tracks and narrow-gage tracks, with ties 8 ft. long for the tram tracks. All switching of main line cars at the plant is done by the two railroads. For handling the tie trams and trains there are two 35-ton, four-wheel steam locomotives which are equipped with special spark-arresting devices. The yard area now occupied is graded level and covered with about 12 in. of cinders. Watchmen keep the yard cleared of waste paper and other litter, as a precaution against fire.

Parallel tracks spaced 110 ft. c. to c. extend through the yard, each track being in an open passageway 17 ft. wide between stacks of ties. Alternating with the tracks are passages or roadways about 8 ft. wide and in these the water mains may be placed later. Ties are stacked according to size and on the 9 to 1 system, unless otherwise specified by the owner, with about 700 ties to each stack. In length, 8-ft. and 8½-ft. ties are found to be required in about equal quantities. A minimum space of 4 ft. is left between adjacent stacks to provide ample circulation of air for seasoning.

Ties purchased by the timber companies and those sent by the railroads are usually inspected before delivery, but all are marked by paint or a hammer stamp to show the month and year of arrival at the yard. Gondola cars average 300 to 400 ties according to cubic capacity, as usually there is not sufficient space to load them to their weight capacity. Box cars average 300 to 500 ties according to the rated capacity in weight.

Handling Ties—All unloading and loading of ties is done by hand, colored labor being plentiful and the men quickly becoming expert. As it is piece work they can earn much or little as they desire, and as they are paid daily they are generally well satisfied. Manual labor is considered preferable to the use of mechanical conveyors or appliances under these conditions, especially as ties are delivered in both box cars and open cars, so that different appliances would be required. It is stated that one man working steadily can unload and stack about one carload of 300 to 500 ties in an 8-hour day.

This unloading is done as a rule by two-man gangs,

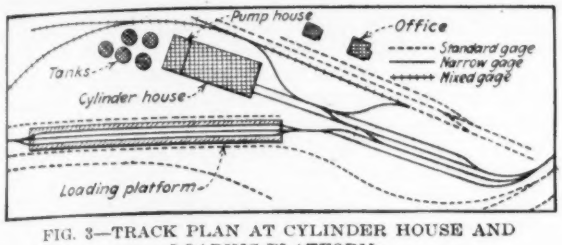


FIG. 3—TRACK PLAN AT CYLINDER HOUSE AND LOADING PLATFORM

each gang unloading two cars, or the equivalent of one car per man. For each car received the number of ties is shown on the waybill. The foreman in charge of unloading assigns the men to the cars and counts the ties as soon as they are unloaded. He checks his count with the men and at the end of the day he turns in to the office his account of the number of ties unloaded by each man.

In the layout of the treating plant and its yard connections the experience of several years with other similar plants operated by the Ayer & Lord Tie Co. has been a guide, but there is one departure from the usual track plan in order to facilitate movement of the tie trains. Ordinarily the train pulled out of the cylinder is backed down to the unloading platform, the empty train being then pulled forward again from the platform and backed into the yard. But in the Louisville plant, the tracks at the loading platform are continued back to the rear of the tie yard (see Figs. 2 and 3). Thus an empty train can be pushed directly to the end of the yard, and then pulled into any desired track for reloading. In this way the switching work around the plant is reduced materially.

Treating Cylinders.—Two treating cylinders are provided and there is space for four, as shown by Figs. 4 and 5. Each cylinder is 7½ ft. in diameter and 131 ft. long, built of ⅜-in. plate with double-butt straps triple riveted. All riveting was done with a gap riveter exerting a pressure of 150 tons on each rivet and the cylinders were tested to 300 lb. pressure at the builder's shops, while the maximum working pressure will be about 180 lb. One end is closed by a steel head and the other is fitted with the usual swing door, this door being forced tight when closed by forty 2¼-in. T-head bolts hinged to the end ring of the cylinder and fitted to slots in the door ring. Each cylinder was shipped complete with all fittings attached, occupying four flat cars, and was set in place by means of jacks and blocking.

Double angle irons riveted to the shell of the cylinder form the track for the tie trains and along the bottom

FIG. 4—CYLINDERS AND TANK EQUIPMENT
Treating cylinders below and pressure cylinders above. Space at right for duplicate equipment. Pump house at rear with working tanks beyond.

are laid the heater pipes. A shallow pit is required in front of the cylinder to give clearance for the door. When the cylinder is open, this pit is bridged by short pieces of rail which are placed and removed by hand.

Above each treating cylinder is a pressure cylinder 7½ ft. in diameter and 131 ft. long, built of ½-in. steel plates with double-riveted lap joints and tested to 150 lb. This cylinder is filled with oil or solution when the first air pressure is applied in the main or treating cylinder, the air being then admitted to the top of the pressure cylinder to force the oil into the main cylinder. The upper cylinder is mounted on steel brackets riveted to the shell of the main cylinder so that both cylinders are free to expand and contract independently. After treat-

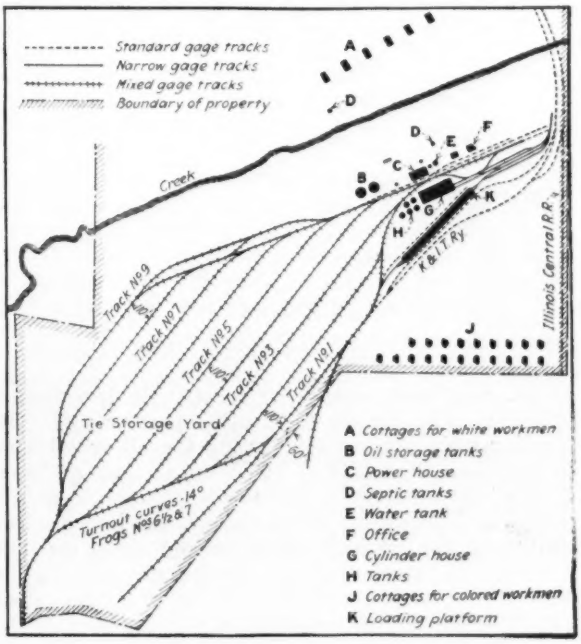


FIG. 2—PLAN AND TRACK LAYOUT OF TIE YARD AND TREATING PLANT

ment, the surplus oil in the main cylinder is blown back to the working tank.

An unusual feature is the application of cylindrical heaters with steam coils for heating the oil rapidly after it enters the treating cylinder. Each heater is 12 in. in diameter and 12 ft. long, placed diagonally at the side of the cylinder (see Fig. 4), the lower end being connected to the bottom of the cylinder and the upper end to the side of the cylinder, thus providing for oil circulation in the heater. Practically all movements of the oil or solution in the piping systems are by gravity or air pressure, pumping being used only to fill the working tanks from the large storage tanks.

The tie trams are of cast steel with hinged hoops to hold the ties in place. Each tram will hold about 70 ties 7 x 8 in. A cylinder charge consists of sixteen trams with 8-ft. ties or fifteen trams with 8½-ft. ties. The trams are moved in and out of the cylinder by the narrow-gage locomotives.

Free longitudinal movement of the treating cylinder in expansion and contraction is provided for by a special form of support which dispenses with rollers or rockers. The cylinder is not anchored at any point but rests on nine cast-iron saddles having their bases

machined and resting on two continuous lines of 110-lb. rails on concrete pedestals. Two of these saddles are riveted to the cylinder shell, but the others are not fastened in any way, so that the shell may move in the saddles or the saddles may slide along the rails. All pipes connected to the cylinders have swivel joints interposed to give ample flexibility to allow for these longitudinal movements of the cylinder.

Cylinder House and Pump Room—The cylinder house has a concrete floor and low side walls supporting steel columns and roof trusses (see Fig. 5). The sides are of asbestos-metal sheathing and the roof is covered with corrugated asbestos. Across the rear of this shed

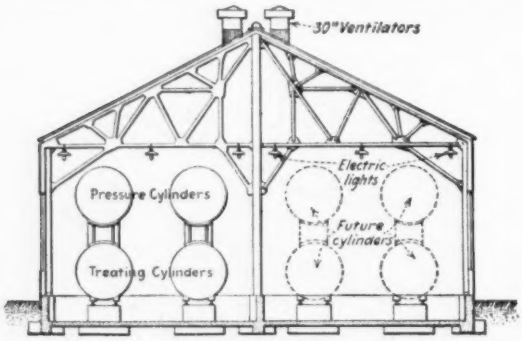


FIG. 5—SECTION OF CYLINDER HOUSE

is the pump and compressor room, with two steam-driven air compressors to give the pressures for the treating cylinders and for forcing the oil or solution to and from the cylinders and working tanks. There is also a vacuum pump for use when vacuum is required as part of the treating process. Two electric generators are provided, one driven by steam and the other by an oil engine for use when the boilers are shut down. In this room also are the recording gages and instruments. A concrete basement contains the pipe connections between tanks and cylinders. It forms a concrete tank with a drain for carrying off seepage water. In case of failure of a pipe connection the oil would flow into this basement. Since an iron grating forms the upper floor, any such leakage would be promptly noted by the attendant, who would drop a gate valve closing the drain. The oil could then be salvaged by pumping.

Tank Equipment—Concrete towers 22 ft. high support four steel working tanks, 28 x 24 ft., of 100,000 gal. capacity each (see Fig. 1). Each treating cylinder with one tank for creosote and one for zinc solution forms a complete unit which can operate any desired treating process. There are no cross connections between these units, thus avoiding possible mischance in connecting a cylinder to the wrong tank. The third zinc tank on low foundations, is for storage of a 55 per cent zinc solution. A tank 5 ft. in diameter and 10 ft. high is provided for measuring definite quantities of the 55 per cent solution to be mixed with water in the zinc-solution working tank which is connected with the treating cylinder, the strength of the treating solution being from 2 to 4 per cent.

An open tank 10 ft. in diameter and 6 ft. high receives water from the well, and from this the water is pumped to the elevated tank. There is also an air receiver 5 x 15 ft. for 100-lb. working pressure and a 20,000-gal. fuel-oil tank 10½ ft. in diameter and 32 ft. long. For storing creosote oil brought in by tank cars there are two 285,000-gal. steel tanks 45 ft. in diameter and 24 ft. high, on ground foundations. A steam pipe is led to the oil-car track for heating the oil in the tank cars to facilitate pumping in cold weather. Most of the oil now used is imported from Europe, the domestic supply being inadequate.

Loading Platform—Adjacent to the cylinder house is a roofed loading platform 35 x 460 ft. consisting of an earth fill between concrete retaining walls (see Figs. 2 and 3). On this platform are three 36-in. tracks for tie-tram trains, their rails being 4 ft. above the rails of standard gage tracks along each side of the platform, as shown in Fig. 6. A steel shed roof with long eaves forms a protection from the weather, the high roof and open sides giving ample ventilation in summer. Snowfalls are rare but the roof is given a steep pitch in order that dry snow will slide off.

Miscellaneous Facilities—A power house contains three 200-hp. boilers and two large fire pumps and has also a machine shop for general plant repair work. This building is of concrete frame construction with red brick curtain walls and corrugated asbestos roofing on steel trusses. Steam pipes are led through a tunnel to the pump house of the treating plant. Coal is shoveled from cars on an outside track to the firing floor, no large storage supply being provided. As shown in Fig. 7, the steel stack is braced by a structural steel frame or tower in order to avoid the use of guys, since these might be pulled down by the 20-ton locomotive crane which is used in handling piles and timbers and for handling cinders, filling, etc., with a grab bucket.

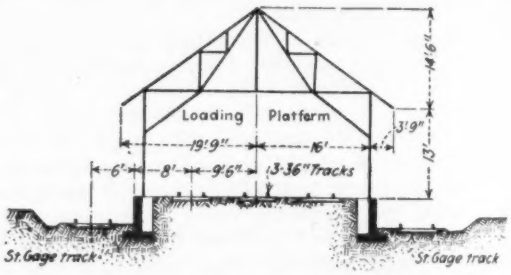


FIG. 6—SECTION OF COVERED LOADING PLATFORM

For the same reason there are no overhead wires about the plant.

A single well with an air-lift gives an ample supply of water suitable for boiler use, and this water is pumped to a 100,000-gal. steel tank on a tower 70 ft. high. Beyond the tank is the office building and a building for the use of inspectors for the railroads, both of these being of hollow-tile construction.

Living accommodations are provided for the employees. On the north side of the plant are six cottages of hollow-tile construction for the white workmen and on the south side are seventeen four-room frame buildings for the colored workmen. A low rent is charged for these houses. Each group has water service, electric light, sewers and a septic tank. A third septic tank serves the toilets of the treating plant. With the exception of the residences for the colored workmen the entire plant is of fireproof construction, the extra cost being balanced by the greater safety and the saving in maintenance.

Grading, tracklaying and much of the smaller con-

struction work was done by the company with its own forces. The treating cylinders, pressure cylinders and all steel tanks were built by the Reeves Brothers Co., Alliance, Ohio, using its own designs and details. After the general plan had been prepared under the direction of A. M. Smith, superintendent of treating plants of the

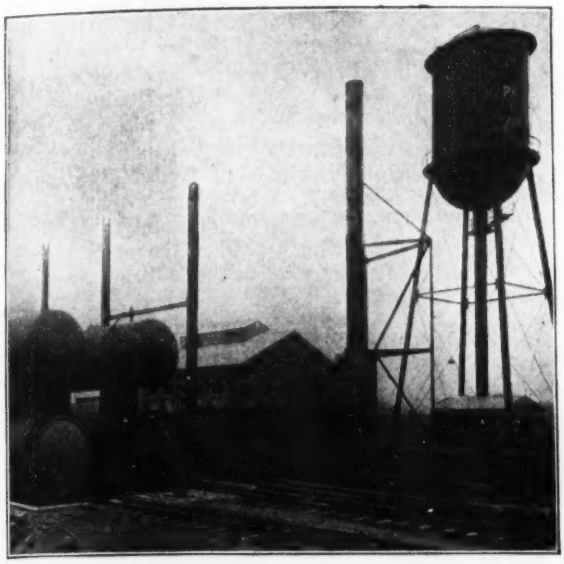


FIG. 7—TREATING CYLINDER AND POWER HOUSE
Note steel tower for bracing smokestack.

Ayer & Lord Tie Co., structural designs were worked out by the Leonard Construction Co., Chicago. All construction work was carried out under the supervision of Mr. Smith, with L. L. Craig as resident superintendent for the Producers Wood Preserving Co.

Responsibility for Loss from Transmitted Fire

An important change in the French laws governing responsibility for fire originating on one property as causing damage to a neighbor has been made in a law published last year and noted in *Le Génie Civil* recently. The law as it existed up to the present held every person responsible for damage resulting from his own acts or those of his subordinates, or originating in his property. The apparently all-inclusive scope of this law was tempered by judicial interpretation, under which the application of the law was limited to cases where the person in question was in some measure at fault; two years ago, however, the highest court rendered a decision which in effect wiped out this limitation. Thus, a fire originating on a given piece of property without the slightest contributary fault of the owner would yet render him liable to all his neighbors for damages caused them by the fire or by happenings in connection therewith. The result of the decision was a sharp rise in insurance premiums to cover the added risk. Resulting protests have now led to the passage of a supplementary law which explicitly provides for the limitation of the old law to cases of culpability. Under the supplementary law the owner (or tenant) of the premises in which the fire originated is not responsible for outside damages unless the fire was due to his fault or that of persons for whom he is answerable. This supplementary law, unlike the main law, refers only to fire, not to all forms of disaster.

Electrification Project Recalls Maltrata Location

Famous Incline on Road from Vera Cruz to Mexico Monument to Skill of Captain Talcott, American Railroad Engineer

By Emile Low
U. S. Assistant Engineer, Buffalo, N. Y.

THE recent award of a contract for electrical equipment to be installed on a section of the Mexican Ry. from Vera Cruz to Mexico City not only marks the commencement of the first railroad electrification in Mexico, but also reminds the engineer of one of the most noteworthy pieces of railroad construction of which there is record. This is the so-called Maltrata incline on the line of that railroad between Orizaba and Boca del Monte.

This railroad is 264 miles long, the eastern terminus being at Vera Cruz on the Gulf of Mexico and the western at the City of Mexico. The original survey was made by Capt. Andrew Talcott in 1858 for Señor Antonio Escandon, a Mexican capitalist, but the unstable conditions in Mexico at the time of the presentation of Captain Talcott's report, in March, 1859, prevented for the time being the construction of the proposed road.

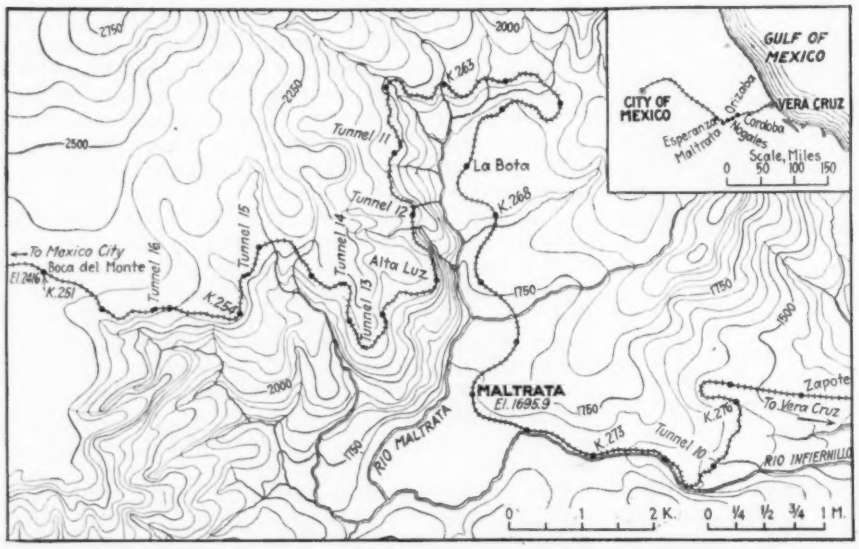
European Intervention in Mexico—The question of a joint intervention in Mexican affairs by Great Britain, France, Spain and Prussia was mooted in 1860, and on Dec. 14, 1861, a Spanish fleet appeared before Vera Cruz, which was at once occupied by the Spanish troops under General Prim. The French arrived soon after, and in September, 1862, more French troops arrived. In view of the unhealthfulness of Vera Cruz, the convention of Soledad was concluded with the Mexican government, permitting the foreign troops to advance to Orizaba.

The French, on their arrival in Mexico, found no railroad except the few miles of track operated by mules from Vera Cruz. This was used to transport passengers and their baggage about nine miles to Tejeria, whence transportation to the interior was over old Spanish highways that at many points were almost impassable during the rainy season. Efforts were immediately directed towards the construction of a railway across the Tierra Calienta.

Construction Begun—Captain Talcott did not return to Mexico until March 1, 1862, having left Charleston, S. C., on Jan. 9, 1862 on the blockade runner "Carolina" for Nassau. He then reached Vera Cruz via Havana and on his arrival resumed his duties in connection with the construction of the Mexico and Pacific R.R., as it was then called, for which Señor Escandon held the concession. It was not until after the arrival of Emperor Maximilian, at Vera Cruz, May 28, and at the City of Mexico, June 19, 1864, that more rapid construction progress was made. The name of the railroad was changed to "The Imperial Mexican Ry. Co." and a contract entered into with Smith, Knight & Co., Ltd., who undertook to "complete and construct a railway from Vera Cruz to the City of Mexico and a branch railway to Puebla, according to the plans, sections and specifications in that behalf made by Captain Talcott." Captain Talcott severed his connection with the Imperial Mexican Ry. on Feb. 10, 1867, arriving in New York April 5, 1867. He was then seventy years old.

After the downfall of Maximilian and the withdrawal of the French army, the Mexican government, on Nov. 27, 1867, made a new contract with Señor Escandon. This contract was again modified on Nov. 11, 1868, and the railroad was completed on Dec. 31, 1872, under the Escandon grant, sixteen years after his first contract was made. It was formally inaugurated on Jan. 1, 1873, by President Sebastian Lerdo de Tejada.

Captain Talcott—Between Orizaba and Boca del Monte lies the famous Maltrata incline, which, as an engineering achievement, is without parallel in railroad construction. This section, together with other portions of the railroad, is an everlasting monument to the ability of Captain Talcott, who located the line and constructed the major portion of the road. Captain Talcott was born in Connecticut, April 20, 1797. He was graduated from the West Point Military Academy and promoted in the United States Army to brevet second lieutenant, Corps of Engineers, July 24, 1818, and to



THE MALTRATA INCLINE BETWEEN VERA CRUZ AND MEXICO CITY

captain, Dec. 22, 1830. He resigned his commission in the army Sept. 21, 1836. During his civil life he served among many other engagements, as adjunct chief engineer, New York & Erie R.R., chief engineer Richmond & Danville R.R., and chief engineer, Eastern Division, Ohio & Mississippi R.R., resigning from the latter position to become chief engineer of the Mexico & Pacific R.R. Dec. 1, 1857, at a time of life when most men think seriously of retiring from active duties.

The corps of engineers organized by Captain Talcott landed in Vera Cruz Jan. 4, 1858. The problem proposed for their solution was to find the most direct and practicable line for a railroad between the commercial and the political capitals of the republic.

The Location Problem—The route was evidently difficult, because there was a mountain to be climbed. The broad table-land of that part of Mexico is, in round numbers, 8,000 ft. above sea level. This great elevation is reached in the first one hundred miles from the coast. If the slope of the land were uniform and unbroken, an average rise of 80 ft. in each mile, while troublesome, might not be thought a serious obstacle; but the ascent is neither even nor uninterrupted. At 95 miles, it has risen to 5,500 ft. Then, suddenly, within a distance of five or six miles, as the wagon road runs, the mountain raises itself 2,500 ft. higher still, up to the *cumbres* or sharp edge of the table-land which stretches away in the nearly level plain for 400 miles.

The stage route climbed the mountain by the pass at Aculcingo by a series of ten or twelve extended zigzags. A railroad could hardly do that. After one height was reached, there was another beyond it, and the attempted line of survey became hopelessly involved in a veritable tangle of hills. A month was spent in trying the possibilities of the ground and the result was failure. Then the scouting party reported that a few miles to the north was another pass up from Maltrata, and on the further side of it, a very long mountain spur thrust out for miles into the lower country, a kind of buttress to the table-land. Thither the party turned. They found no carriage road in the Maltrata Pass and the zigzag turns for horse and mule trains were even more numerous than at Aculcingo, but hope was fixed on that prolonged spur of the mountain, the side of which towered half a mile above the village and was as yet unexplored and covered with low trees and tangled brush. After climbing up the path to Boca del Monte, the mouth of the mountain, the transit was set at a downward gradient of 200 ft. to the mile and with this as a guide, the mountain side was explored.

The leveling instrument was close behind. At last, after eleven miles of sharp descent, the low level of the village of Maltrata was successfully reached, but there was more to come. The water drainage of the valley is through a narrow gorge, so wild that the local name for it is the Barranca de Infiernillos, or in English, the Ravine of Little Hell. Down this rocky gorge the line plunged on, turning and twisting, until at last, in the valley of Encinal, it came out into the midst of smooth fields and ten miles of a straight course brought it to Orizaba. In twenty-five miles the descent is 4,000 ft. The average of that is 160 ft. to the mile, but many miles are on a grade of 211 ft. and even more.

The original line was run by William R. Eastman, chief of party, under Captain Talcott. He is still alive and for many years lived in Albany, N. Y. One of the principal engineers connected with the construction of the Maltrata incline was Sebastian Wimmer, who died Nov. 30, 1921, at an age of nearly 91 years. Mr. Wimmer, who arrived on the work April 26, 1865, was first in charge of the seven upper sections of the line, and afterwards in charge of additional sections, lower down, near Maltrata. The Emperor Maximilian visited the work April 29, 1865, and was a guest at a dinner given by the contractors, Smith, Knight & Co. During the dinner he was apprised of the assassination of President Lincoln, it having taken two weeks for the news to reach this place.

Paris Stadium Design Has 131-Ft. Cantilever Roof

Government's Chief Architect Is Collaborator in Plan of Unique Structure Submitted as Olympic Games Possibility

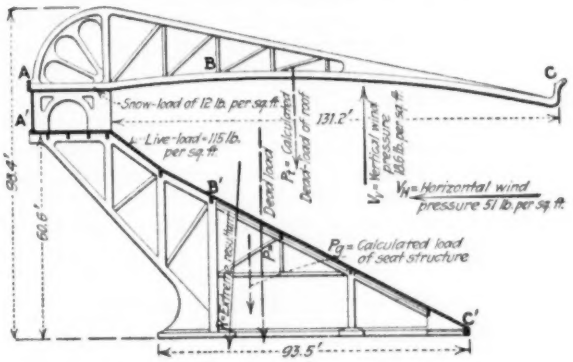
The following article, taken from a recent issue of Le Genie Civil presents with little detail, except as to forces involved, a design for the Paris stadium which it is proposed to construct in order that the large crowd expected at the 1924 Olympic games may be accommodated. At the present time there is no stadium in Paris or in the environs capable of taking care of more than 20,000 or so spectators. The Olympic committee, after making an examination of available structures with a view to their enlargement, decided that an entirely new edifice was preferable. The structure herein described is the joint design of G. Tronchet, architect in chief of the government, and of Henry Lossier, a well-known Paris engineer. According to Le Genie Civil this joint design is the most acceptable of all that have so far been submitted. Obviously there are structural details which the American engineer would be interested in discovering: For instance, dimension details of structural members and how the cantilever roof and seating structure are joined. —EDITOR.

AMONG the designs for a new stadium submitted to the French Olympic committee charged by the International Committee of Olympic Games with arranging for the 1924 athletic carnival in Paris, perhaps the most interesting and what the committee believes to be the most daring as well as structurally sound design, has been submitted by G. Tronchet, chief architect of the government, and Henry Lossier, a well-known Paris engineer. The structure, a rectangular stadium with semi-circular ends, would be entirely of reinforced concrete and offer a seating capacity of 80,000. The seating area is entirely covered by a cantilever roof with a span of 40 m., or a little more than 131 ft. This daring design therefore allows clear vision for each of the 80,000 spectators. The design contemplates the most extreme conditions of loading, both dead-load and live-load, of vertical and horizontal wind pressures and of snow loading.

As indicated in the accompanying figure the calculated load of the roof acts in a direction indicated by the vertical line P_t, while the calculated dead-load of the seats themselves follows P_g. The resultant of these two forces passes through the center of gravity of the section. Theoretically it would suffice to eliminate any point of support to the right of this force in order to assure the stability of the structure under permanent load.

However, as varying snow load, the pressure of the wind and the load of the seats themselves tend to displace their resultant within certain limits of the center of gravity of the loaded structure, it would be necessary to give to the base of the structure a sufficient width to assure its stability under the most unfavorable conditions of loading. These most unfavorable conditions are believed to be realized by the simultaneous action, in the most extreme conditions, of the following elements: Horizontal and vertical wind action, snow load and dead- and live-load of seating area.

Wind Action—It is generally admitted that, conforming to the regulations laid down in 1903 for governing construction of railway stations, wind pressure is able to attain 28 lb. per sq.ft. on the surface normal to the wind direction, and that in certain instances there is brought into play in addition to the direct horizontal pressure of the wind, a suction acting on the opposite wall, whose value varies in general from 5 to 6 lb. per



DARING CANTILEVER DESIGN FOR PARIS STADIUM

square foot. With this in mind M. Lossier has incorporated in the design conditions much more severe than these, considering them to be acting simultaneously. These conditions are a direct pressure of the wind of 51 lb. per sq.ft., acting in a horizontal direction from the interior toward the exterior of the structure, and an under pressure acting in a vertical direction against the under side of the roof of 18.6 lb. per square foot. The two engineers feel that with such excessive wind pressure they have a wind factor of safety that would safeguard the structure from overturning on that account.

Snow Load—According to a building regulation passed in February, 1903, snow load is reduced to about 6 lb. per sq.ft. when it acts simultaneously with wind pressure. However, M. Lossier has applied on that portion of the cantilever, marked in the accompanying figure, *A-B*, a snow load of 12 lb. per square foot. The point at which this snow load is presumed to be concentrated (see accompanying figure) in the design is the most unfavorable so far as its action is concerned toward overturning the structure toward the exterior.

Live-Load—The live-load which is imposed by the crowd, presumed to be 80,000, has been fixed at 115 lb. per sq.ft., a design which corresponds to a regulation laid down in 1915 relative to the calculation of stresses in metallic bridges. This live-load has been applied only on the zone marked in the accompanying figure *A'B'*, that is to say, on that part of the cantilevered seating structure and the promenade at the top. The concentration point of this live-load also is the most unfavorable from the standpoint of overturning action.

The resultant *R*, found then by simultaneous action of:

1. The dead-load of the structure.
2. Horizontal pressure of the wind of 51 lb. per sq.ft.
3. An upward vertical pressure of the wind of 18.6 per sq.ft. acting on the under side of the roof.
4. A snow load of 12 lb. per sq.ft. acting on the section *A-B*, and
5. A live-load of 115 lb. per sq.ft. concentrated in the

center of the section *A'B'*, is found to pass to the right of the center of gravity of the section, thereby insuring the stability of the structure under the most adverse circumstances.

The roof would be constructed of reinforced-concrete tile. In building the structure utilization of standard elements, formwork, etc., to permit of a reduction to minimum in delays of execution in spite of the exceptional dimensions of the structure, would be made.

The cost of the structure as designed would be, according to its designers, in the neighborhood of 480 francs a square meter. Inasmuch as there are 33,000 sq.m. of seating area this would mean an expenditure of more than a million dollars. According to M. Drouge, inspector-general of Ponts et Chaussées, charged with making a report upon the various plans submitted, this price could be considerably lowered by putting in a line of supporting columns about 15 ft. from the back tier of seats.

Causes of Distortion Failures of Asphalt Pavements

Extracts from a paper by H. W. Skidmore, Consulting Engineer, Chicago Paving Laboratory, Inc., presented to annual convention of the Iowa Engineering Society.

DISTORTION under traffic is of two kinds, forward displacement and lateral displacement. The latter occurs on thoroughfares which are subjected to swiftly moving traffic. Forward displacement is developed under heavy traffic moving at a comparatively slow rate.

Undoubtedly the most fertile cause of displacement so far as the mixture composition alone is concerned is too much bitumen and insufficient fine mineral or filler. Although it is not the only factor which affects the stability of the composition, high density does more to insure freedom from displacement than any other one thing, when it is accompanied by a bitumen content just sufficient to coat the particle.

Example 1—The pavement had been in service only a few years, carrying heavy arterial, highway traffic in the vicinity of Chicago. Heavy trucks during hot weather caused excessive rolling but only in certain sections of the road, and by no means could it be called general. The following analyses, taken from two different rolled sections, show that about 3 per cent too much bitumen was used. Comment on the grading of the aggregate is superfluous.

Sample	I	II
Bitumen, per cent	11.7	12.0
Mineral passing 200 mesh, per cent	12.7	12.5
Mineral passing 80 mesh, per cent	14.1	13.0
Mineral passing 40 mesh, per cent	27.5	25.5
Mineral passing 10 mesh, per cent	9.0	8.0
Mineral passing 4 mesh, per cent	18.0	23.5
Mineral passing 2 mesh, per cent	7.0	5.5

Example 2—Another example of a badly rolled asphaltic concrete pavement is represented by the following analysis of a sample taken in an Iowa city:

Bitumen, per cent	11.2
Mineral passing 200 mesh, per cent	13.9
Mineral passing 80 mesh, per cent	12.0
Mineral passing 40 mesh, per cent	19.8
Mineral passing 10 mesh, per cent	25.2
Mineral passing 4 mesh, per cent	15.5
Mineral passing 2 mesh, per cent	2.4
Specific gravity of mixture	2.32

Again we find the bitumen entirely out of proportion. The specific gravity in this case seems relatively high and indicates good density; but the virtue of density is destroyed by the excess of bitumen, which bears out a previous statement that density must be accompanied by the proper amount of bitumen. The underside of this sample was worn smooth from slipping on the concrete base.

Example 3—Another example of rolled mixture is given below, and in this case a somewhat different condition arises, as the bitumen content would not have been excessive had the fine mineral been sufficient. The most obvious defect in this mixture is the shortage of 80-mesh particles, which undoubtedly detracts from the stability of the structure:

Bitumen, per cent	7.7
Mineral passing 200 mesh, per cent	7.1
Mineral passing 80 mesh, per cent	4.0
Mineral passing 40 mesh, per cent	11.6
Mineral passing 10 mesh, per cent	18.8
Mineral passing 4 mesh, per cent	33.1
Mineral passing 2 mesh, per cent	17.5

Example 4—Rutting may occur in a mixture which would ordinarily be considered fairly good for normal or moderate traffic. The case of the sheet asphalt pavement which rutted badly in two years of service under boulevard (or swiftly moving) traffic as given below, will serve to illustrate this fact. The first of these analyses is of a sample from a badly rutted section and the second is from a portion which showed slight rutting at the end of four years; both are from the same street.

Sample	I	II
Bitumen, per cent	11.3	11.7
Mineral passing 200 mesh, per cent	10.9	14.1
Mineral passing 80 mesh, per cent	23.4	26.5
Mineral passing 40 mesh, per cent	34.7	33.9
Mineral passing 10 mesh, per cent	18.2	12.7
Mineral passing 8 mesh, per cent	1.5	1.1
Specific gravity	2.14	2.18

Asphalt cement of 60 penetration used.

The higher gravity of sample No. 2 is easily accounted for by the fact that it shows a much more balanced grading than No. 1. While No. 2 carries slightly more bitumen than No. 1, the grading of the aggregate and the pressure of more filler explains why it did not rut as badly as No. 1 Undoubtedly the penetration has a great deal to do with encouraging the distortion of this mixture, as the pavement is not shaded at any period of the day. The penetration in this case should have been about 35 instead of 60.

Failure of Two Small Dams

RECORDS of the failures of dams are always of interest, even in the case of small structures, and in the case here noted the failure of an old timber dam resulted in the loss of an earth dam and hydro-electric plant a mile below it. This accident occurred Dec. 12, 1922, at Iron River, Wis., about 25 miles west of Ashland, Wis.

A timber dam was built at Iron River about 1870 to provide power for operating a sawmill, but in 1921 the Iron River Water, Light & Telephone Co. replaced this old structure with an earth dam carrying about 17 ft. head and having concrete flumes and wasteways. Immediately below this dam was located the steam plant which had been used to supply the village with light and water. A new hydro-electric generating station was also built in 1921, but the old steam plant was retained. About a mile above the Iron River dam was located the Mud Lake dam, an old wooden structure originally built for log driving and holding about 6 ft. of water. This also was owned by the Iron River Water, Light & Telephone Co. and was used to impound water as storage for the dam and new plant at Iron River. Another storage dam was located still farther up the stream. The Mud Lake dam is said to have been in poor repair, not having been put to any use since old log-driving days until a year or two ago.

About 7:30 a.m. on Dec. 12 the Mud Lake timber dam gave way. There was considerable storage behind this dam, while the capacity of the reservoir above the Iron River dam was small. As a result the rush of water was so great that the Iron River dam was carried away. With it went the new hydro-electric generating station as well as the old steam generating and pumping plant. The loss is said to be estimated by the company at $75,000. It is reported also that the company suspects the dam was tampered with and weakened.

City Planning and Zoning in Old Communities

By-Passing Through Traffic, Store-Door Deliveries, Decentralization of Department Stores and Office Buildings Suggested

By George H. Herrold
City Plan Engineer, St. Paul, Minn.

Abstract of a paper before the Minnesota Federation of Architectural and Engineering Societies.

THE problem of a city planner in an old city is to make the most of existing streets by (1) the regulation of and routing of traffic; (2) by widening certain streets, revising grades and straightening alignment to increase the economies of transportation; and (3) by assigning the use of property along the street after due consideration of land values, topography, proximity to railroads, waterways, existing improvements, etc. The surveys or research work required for the solution of these problems cover a wide field.

Under traffic studies we have traffic counts, origin and destination of traffic, kind of vehicles, their weight and size, commodities carried, cost per ton-mile, location of principle traffic sources, method of expressing traffic in units of obstruction value, time losses due to circuitous routes, time losses due to congestion, and left-hand turns, power losses due to grades and road surfaces, special traffic such as freight house traffic, number of vehicles in service, street widths and capacity of streets.

From these data deductions may be made in a scientific manner as to the location of truck routes, general traffic routes, belt-line streets and by-passes with roadway widths expressed in lines of traffic and width for parking and ranking, methods of increasing transportation movements by regulation, establishing arterial streets, one-way streets, platoon system of moving traffic, store-door delivery of freight by railroad companies to reduce the number of trucks on the streets.

A number of problems are introduced which may be matters of policy or leniency. For instance, can streets dedicated for public use be consistently used for ten-hour storage of cars or are they to be considered as traffic ways for the use of moving cars and necessary stops only for transacting business. Is it a legitimate function of a municipality to go into the storage business, financing storage garages or creating storage areas? Can public squares dedicated as such have storage space constructed under them by a municipality if the park spaces are maintained above without losing their rights to these parks?

Traffic Congestion—By-passing traffic is a legitimate way of reducing traffic in congested areas. Traffic studies have proven that through traffic has little buying power, notwithstanding the erroneous viewpoint of storekeepers. This traffic can be by-passed around the congested area without any loss to the storekeeper.

In St. Paul there is one motor vehicle for each ten persons. In 1920 there was one motor vehicle for each thirteen people and in 1915 one motor vehicle for each fifty-six people. It is estimated that the point of saturation will be reached when there is one motor vehicle for each five persons, which will double the number of the local vehicles on the street, but this number will still further be increased by another situation. In the days of horsedrawn vehicles the area tributary to a city within a day's journey or 15 miles radius was 700 square miles—today with the automobile the radius is 80 miles or an area of 20,000 square miles.

Store-Door Deliveries—The number of traffic vehicles on the street will be lessened by railroad companies making store-door deliveries. At the present time each firm has its own truck that makes numerous calls at the freight station getting little jags of freight and hauling them through the streets to the owners' place of business. A railroad truck fully loaded making one trip over the street and making store-door deliveries might eliminate as many as ten trucks belonging to these firms. Union freight stations are ideal from the shipper's standpoint. They facilitate delivery of outbound freight, but require large paved areas around them and complete regulation of time of deliveries.

There are now under consideration by traffic men in St. Paul joint consolidating and forwarding stations to serve all railroad lines entering the city.

Decentralization of Department Stores, Office Buildings, Etc.—Heretofore stores have been located where street car traffic and pedestrian traffic was the heaviest. The automobile is now rapidly changing this viewpoint, too dense a traffic is no longer an asset. Safety no longer exists and the difficulty of finding a parking place for a car within several blocks of the store at which you wish to shop is becoming irksome. The next great innovation in city building will be the construction of a department store several miles out near some great artery with ample space, privately provided, for the parking of customers' cars. Office buildings to house the professions might as well be located several miles out of the central business district—one, two or three blocks off from an arterial street. Architects, engineers, lawyers, doctors, dentists, artists and musicians of established reputation now locate in the central business district because of habit, not of necessity, for their customers come to them. So for our future development we may look for a decentralization which will in itself take care of some of our traffic problems. We have long considered that the whole problem has been one of improving and increasing traffic facilities to the central district. Our thoughts should now be on ways of lessening this traffic burden by decentralization.

Traffic Studies in St. Paul furnish some interesting facts. On University Ave. traffic steadily increases from 7 a.m. to 6 p.m. when it suddenly drops. Automobile traffic is 83 per cent of the total. Light truck traffic has its peak load between 9 and 11 a.m. and from 2 to 4 p.m. Heavy trucks are only 3.2 per cent of the total traffic and are a maximum in the forenoon. Horse-drawn traffic is 1.4 per cent of the total.

On Marshall Ave. Bridge 87 per cent of the traffic is automobiles. Heavy truck traffic is negligible, and the afternoon traffic is 71 per cent greater than the forenoon traffic.

In the Central business district the afternoon traffic is 13 per cent heavier than the morning traffic, and the maximum load is from 5 to 6 p.m. Truck traffic is the heaviest between 7 and 8 a.m. and between 3 and 4 p.m.

The theoretical capacity of a 40-ft. roadway with a double car line on it is 528 vehicles per hour in each direction; that is, this is the volume of vehicular traffic which the streets can be made to carry under proper traffic regulations and *no parking*. The average present hourly traffic is 681 vehicles in four directions at Sixth and Robert St. intersection, but there are five-minute intervals when the theoretical limit it nearly reached, which would be 2,100 vehicles per hour.

A close analysis of the factors "rise in grade," "distance" and "time" and their effect on the cost of motor traffic cannot at the present state of the science be made, although elaborate studies are in progress which latter will produce definite formulas for solving these problems. It is noticeable and probably can be proven that where motor equipment can make a quick get-a-way and is uninterrupted in its travel even with bad grades and circuitous routes they will show a lower cost per ton-mile than on level grades but with continuing interruptions from traffic congestion.

Zoning, with Special Reference to Business—A study of our economic necessities in connection with zoning develops some very interesting facts. From information put out by the Dartnel Corporation there are in Minnesota 4 drug stores, 8½ grocery stores, 1.4 dry goods stores, 6 hardware stores and 10½ general stores to each 10,000 people. Comparing this with the U. S. Census Report for the entire country, we find that Minnesota follows the average very closely for drug stores, grocery stores and general stores, half as many dry goods stores and twice as many hardware stores. There is in St. Paul one retail store in the residential area for each 20.3 families. Further, there is one

salesman for nine workers in the United States; for each four factory employees there is one selling the things produced. This cost of distribution is an economic factor that must be reckoned with and it is anticipated that zoning will react favorably toward improving the situation, for combined homes and stores will not be permitted; stores cannot be built in every block but must be confined to the commercial districts. Non-conforming store buildings will gradually be eliminated for two reasons: (1) A store building in a residential district can be bought out by the surrounding property owners and the building sold and the property afterward can only be used for residential purposes. This will raise the standard of the district and appreciate property values far more than any loss that may be caused in the transaction of getting rid of the store building. (2) People will not trade at non-conforming stores after commercial districts have been thoroughly established for the reason that the store in the commercial district will be of higher class and do business at less cost.

Light industry will be confined to light industrial districts. These districts will be higher class and can do business cheaper for the following reason: Factory districts must have railroad tracks crossing streets at grade, wide pavements with heavy foundations for trucks, large water mains, numerous fire hydrants, large sewers for manufacturing wastes, high tension overhead wires for power and lighting, overhead conveyors and other things that are unnecessary and intolerable in a shopping district or residential district.

Also factories should have differential rates on gas and electricity for power, steam and hot water heat, water supply and other utilities, and this is made possible when districts rather than isolated plants, are to be served by the various utility companies.

The area required for commercial business per thousand people is now known and knowing the maximum possible density of population the area required for stores in any given district can be determined. Zoning limits traffic on local and residential streets and this determines the traffic that arteries must carry and knowing their capacity determines whether greater widths or more arteries must be provided. Furthermore, taking public improvements as a whole, we build pavements, sewers and other utilities to serve all probable needs, and these are as a rule the maximum needs. When a town is zoned these improvements are designed to fit the zone and for the service required—narrow light pavements on residential streets and heavy wide pavements in factory districts with a wearing surface to serve the needs of each. Every city now lays sewers larger and more costly than are likely to be needed because this waste is less than the waste of relaying within a few years to fit a new condition. In a zoned city the maximum requirements are known.

City Planning and Zoning Will Lessen Financial Losses—The great financial losses to which a city [without a city plan and zoning] is subject are: (1) Misspent taxes and unnecessary assessment due to a lack of continuity of purpose of succeeding city officials. (2) Depreciated property values from unregulated building, migrations and changing districts. (3) High insurance and utility rates due to mixed building, mixed districts and continued migration of residence districts. (4) Fire losses.

A city plan and a zoning ordinance will decrease these losses.

City planning is a profession in the making; it is a branch of civil engineering bearing fruit of its kind; it is a profession that has not yet standardized its method of collecting, recording and analyzing its observations; it has no standard formula; it has not yet developed its technic. This field now lies before us.

We hear much of the "City Beautiful." Beauty is a by-product of a well worked out city plan. A city that reflects its soul and preserves its traditions in good architecture is a beautiful city if its pattern or framework or setting is properly designed.

Slab Design on Hills and for Irregular Crossings

Slabs Anchored on Steep Grades—Wide Flares on Square Crossings—Triangles at Acute Intersections

By Gustave Reinberg, Jr.
New York City

IN LAYING concrete-paved streets for real estate development, severe grades and numerous intersections of connecting streets often give rise to difficulties not commonly encountered in highway work. In work lately done for the Port Washington Development Corporation at Port Washington, N. Y., the solution of certain of these problems along sound engineering lines was attempted.

The work was done by the Roger Black Company,

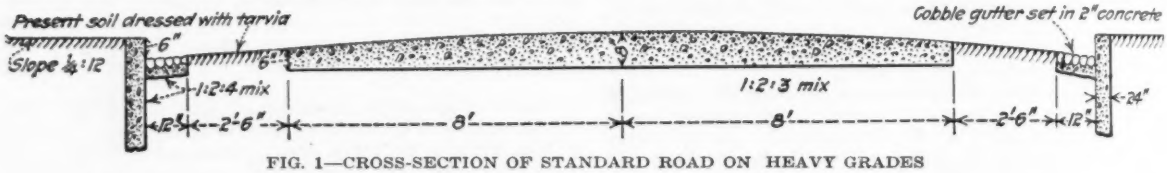


FIG. 1—CROSS-SECTION OF STANDARD ROAD ON HEAVY GRADES

Inc., with J. E. Hasbrouck as field engineer and John W. Ballance as resident engineer.

One of the outstanding features of the work was the pouring of concrete on slopes, ranging from 8 to 15 per cent. A cross-section of the design employed is shown by Fig. 1, the concrete slab being 16 ft. wide, 8 in. thick at the center, 6 in. thick at the edges, and 30 ft. long between expansion joints, which were of asphalt ½ in. thick. The mixture employed was 1 part cement, 2 parts bank sand, and 3 parts coarse, screened bank gravel. The road was poured in a single course, screeded by hand and finished with a broom, to give it a rough, non-skid surface. The scoring was made especially heavy on steep grades to improve the tractive qualities.

On grades of 10 per cent and over some method of anchoring the slabs to avoid creeping was deemed necessary, and in the absence of authoritative precedent it was decided to experiment with two methods of anchorage under parallel conditions. The first of these consisted of a substantial toe on the lower end of each 30-ft. slab, formed by excavating a trench of the dimensions shown in Fig. 2 across the subgrade directly ahead of each joint. To take care of the shearing stress between the toe and the slab, ten ¾-in. deformed steel bars, cut to a length of 2 ft. and bent to an obtuse angle near the center were inserted in the position shown.

The alternative method was a distributed anchor, secured by excavating nine holes, 1 ft. in diameter by 1 ft. deep, in the subgrade directly under each slab, spacing them equidistantly as shown by Fig. 3. As these holes were filled with concrete, five reinforcing bars, 2 ft. long and bent at right angles in the center, were placed in each.

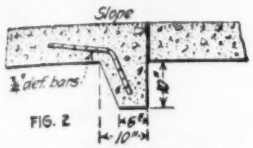


FIG. 2—METHOD OF TOE-ANCHORING SLABS ON HEAVY GRADES

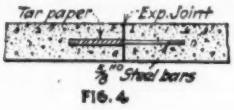


FIG. 4—EXPANSION JOINT DOWELLED WITH STEEL BARS

The surface of the slabs was distinctively marked to indicate the type of anchor used for each, so that it will be possible to determine the relative efficacy of the two systems after the road has been in service for an extended period. The distributed anchor possesses the advantage of requiring a smaller yardage of concrete, but employs several times as much steel for reinforcing as the toe anchor and is somewhat more troublesome to put in unless facilities for cutting and handling reinforcing bars are available. The advantage of this type of anchorage from an engineering standpoint is that a concentration of stresses in the lower end of the slab is avoided.

Aside from the obvious necessity of keeping the mixture as dry as possible (a good mushy consistency was used), and of especial vigilance in finishing the joints to avoid the accumulation of runnage on the upper side, no particular difficulty was experienced in laying road on grades up to 15 per cent. In order to move the mixer expeditiously, however, it is necessary to have the driving mechanism in good condition, and to plank the wheels thoroughly, preferably with heavy cleated treads. Under these conditions it was not found necessary to resort to a block and tackle to move the machine, but this is a possibility if the engine is not a powerful one.

On comparatively level streets the thickness of slab was reduced an inch, giving a 5:7:5-in. road, and a dished cobble gutter was substituted for the curb design. In laying concrete over new fill the construction shown by Fig. 4 was employed, each joint being dowelled with seven ⅝-in. round steel bars, 2 ft. long, placed through the joint material about midway up in the slab. These rods tend to prevent slippage of the slabs at the joints in the event of settlement of the subgrade, and by transferring a portion of the load from one slab to the next they should prevent excessive pressure upon either slab-end. To prevent a bond with the concrete and permit the expansion joint to function, one end of each rod was covered with tar paper. On the 15 per cent grade a similar system of dowelled joints was employed, in addition to the slab anchorage described above, to counteract the buckling effect resulting from end pressure of the slabs.

In the design of street intersections a number of interesting considerations requiring special treatment presented themselves. Each layout was studied by means of a detail drawing considerably in advance of actual pouring, to determine the radius of the connecting flares best adapted to meet the requirements of anticipated traffic and to harmonize in general appearance with the surroundings. The position of expansion joints was worked out and the pouring program arranged in accordance with a comprehensive plan of the entire project. This insured that all streets would be joined in a consistent manner, and the most advantageous layout secured in each case, after taking into consideration all the factors involved.

When approaching an intersection with the actual construction, concrete was laid only up to the point where departure from the normal 16-ft. width occurred. The flare connecting the two streets was then poured as a unit, in such a manner as to avoid all sharp corners or irregular-shaped segments of concrete between expansion joints. Flares with such thin projecting tips are frequently seen, being inevitable where a road is joined to one previously poured without making provision for the intersection. In addition to being unsightly they constitute potential weak places in intersections so made, since they receive only imperfect support from the main body of the slab, and tend to fail rapidly under traffic even when elaborately reinforced.

A diagram of a typical right-angled intersection is

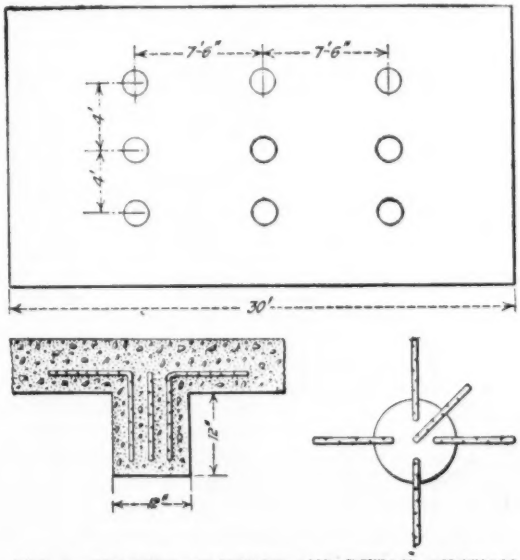


FIG. 3—SPACING OF HOLES AND DETAIL SECTION OF DISTRIBUTED ANCHORAGE

shown by Fig. 5. It will be noted that the flares are particularly generous, the use of too small a radius at corners being a common defect of suburban streets; 16-ft. radii were made standard at right-angle turns, while at irregular crossings, flares of 20 and 22-ft. radius were common, and in an extreme case where a straight street intersected a 46-degree curve, an arc of 47-ft. radius, was used in one flare.

From a number of vital considerations, it was made the general policy to reinforce all intersections. The long flares presented a large surface of thin slab over which heavy traffic might be expected, and which would be very susceptible to damage at the edge, and in spite of the installation of culverts, water mains, etc., at these points as far in advance as possible, there was always the probability of unforeseen contingencies requiring in the future further excavation at or near the intersection.

In dealing with modern truck traffic heavy impact loads may always be expected, as for instance a loaded truck fitted with cross chains on the rear wheels, or a defective tire of the solid block type, where a missing block results in a concentrated hammer-blow being delivered to the slab at each revolution of the wheel. To cope with such conditions particular attention was given to the subgrade throughout, and the precaution was taken to reinforce the road with ¾-in. steel bars wherever local settlement might be anticipated, on the theory that a reinforced slab will act as a unit in distributing

such concentrated stresses over its entire bearing surface. At intersections a network of 16-ft. ¾-in. steel bars was used through the body of the slab, shorter bars being placed fanwise around the flares, and additional reinforcing placed over existing culverts.

The surfacing of an intersection such as that shown by Fig. 5 presents a problem in warped surfaces, which become more or less complicated with the degree of variation between the grades of the streets involved. From theoretical considerations such an intersection

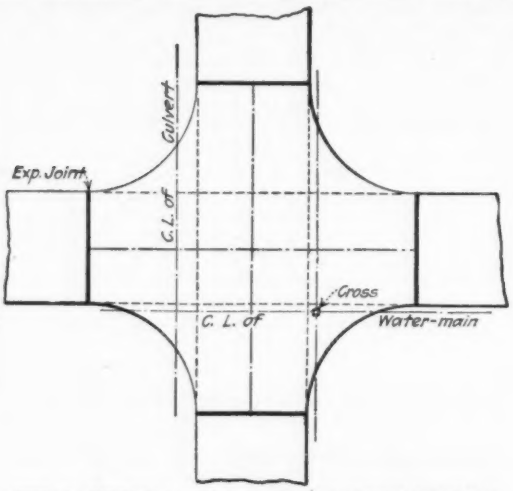


FIG. 5—TYPICAL RIGHT-ANGLED INTERSECTION
Dotted and broken lines show position of temporary screed boards.

might be made with a level 16-ft. square at the center, having the full thickness of slab equal to the crown thickness of the road; effecting a gradual transition from this surface to the normal crown of the four roads, and sloping off the corner segments to the usual edge thickness at the form lines. Such a surface can be approximated by laying temporary wooden forms to the requisite grades, as a continuation of the form lines of each road, as indicated by the dotted lines in the drawing. These boards form a support for a straight-edged screed board used to strike off the surface, concrete being poured simultaneously on both sides of them. After screeding, the boards are pulled up and the spaces filled with fresh concrete and finished with a hand float.

If the grades are very dissimilar such an interesction tends to present a broken appearance, and great care must be exercised in finishing to minimize the abruptness of the transition at intersecting planes. For the majority of intersections a more satisfactory scheme was found in laying temporary forms on the center line of each road, as indicated by the dot-and-dash lines, the normal grade of the roads being carried in each case. The curved forms at the edges were lined up "by eye" to give approximately a straight grade between the edges of the two intersecting roads.

The slab was poured as a whole and screeded radially with a special half-crowned screed, care being used to avoid the formation of a peak at the center. The screed boards were then pulled exactly as in the previous instance. In reality, each intersection presents an individual problem which must be worked out in accordance with the grades existing, and the preponderance of travel to be cared for. Practical considerations will in every case adjust the theoretical to actual conditions.

The majority of these right-angled intersections, being substantially level, were poured entirely without joints, in spite of the large area of slab involved, partly for considerations of appearance and partly to avoid breaking up the slab over water pipe trenches, etc. Of course either or both of the temporary center line forms can be replaced by a permanent expansion joint, and at steep sags of grade a center joint was introduced perpendicular to the line of gravitational stress, this joint being dowelled with 4-ft. rods in the manner shown by Fig. 4. A similar construction might well be employed at sharp summits or wherever the grade of one of the streets at the intersection is excessive.

At several points, the juncture of two curved roads at a more or less acute angle necessitated a triangular layout, having a separate branch connecting the two main roads, with a decorative park in the center. Due

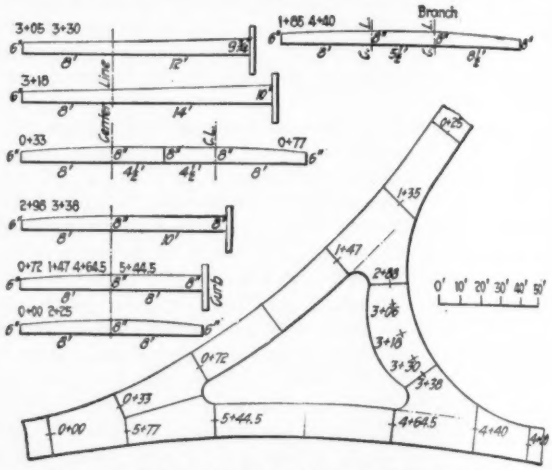


FIG. 6—LAYOUT OF TRIANGULAR INTERSECTION
Position of expansion joints and parabolic widening of roadway at sharp radius and typical cross-sections of slab for triangular intersection.

to the close inter-relation of grades these intersections were planned as a distinct unit, a separate profile being taken and studied in conjunction with a large scale detail drawing in working out the design. In most cases it was necessary to use a comparatively short radius for at least one of the branches, and frequently a severe grade was unavoidable at the same point. Considering the requirements of traffic under such conditions, the roadway was widened from 3 to 6 ft. at these points by using a parabolic curve on the inside of the triangle. Such an intersection is shown by Fig. 6.

In designing the surface the problem of banking the curve is involved. While no consistent policy in this respect was followed in general, an arbitrary banking of from 4 to 8 in. was provided wherever the coincidence of a sharp curve and steep grade made this precaution seem necessary. In the case illustrated, the short branch, having approximately a 50-ft. radius and being at a sag of grade was banked 4 in. and widened 6 ft. at the center. The main roads were not banked but the crown was altered to keep drainage away from the inside edges of the triangle. Typical cross-sections of the road as finally worked out are shown (with an exaggerated vertical scale) by Fig. 6. In screeding this intersection temporary forms were laid as shown by the dot-and-dash lines. In all this work the closest co-operation of everyone concerned was necessary.

Minimum Specifications—Highway Engineering Positions

What Men Must Know—What They Must Be Able to Do—What Characteristics They Must Possess

Abstract of the Report of the American Association of Engineers to be submitted at the annual convention at Norfolk on May 7.

THE AMERICAN Association of Engineers has found it of increasing importance in its employment service to have as a guide for selection, assignment, and promotion clear definitions of the qualifications required for engineering positions. To meet the needs of this service as well as the present urgent demands in the engineering field, the association, several months ago, appointed a committee to specify the qualifications essential to successful work in various engineering positions (see *Engineering News-Record*, April 26, p. 744). This committee has confined its attention for the present to a study of the highway engineering field. An occupational study sheet was prepared and sent to 2,700 highway engineers throughout the country. The data given were compiled on large charts, and a study made of them from which were prepared the minimum requisite qualifications for each position.

This minimum specification is a statement of the things a person must be able to do, what he must know, and the personal characteristics he must possess to function in the position named. The set of specifications so prepared does not attempt to cover all the positions which occur in state, municipal, or private organizations, but it does contain specifications for typical positions from which it will be easy to develop the requirements for each individual position.

Three typical specifications are given below.

MINIMUM SPECIFICATIONS FOR CHAINMAN—RODMAN (HIGHWAY ENGINEERING GROUP)

SKILL:

Under immediate supervision, to clear line for survey, measure distances with chain or tape, hold level or stadia rod, drive stakes for line and grade, establish bench marks, pitch and take down tent, pack and unpack equipment, make simple field sketches and field computations, index field books, and perform such other simple engineering duties as may be required of an aid or helper on survey work.

Fair command of the English language.

KNOWLEDGE:

Care of simple surveying instruments, as chain, tape, level rod, stadia rod, plumb bob, etc.

Sufficient working knowledge of arithmetic, algebra, and geometry to perform the requisite skills.

PERSONAL:

Good physique, active and alert.

Have sense of direction and location.

MINIMUM SPECIFICATIONS FOR CHIEF OF PARTY (HIGHWAY ENGINEERING GROUP)

SKILL:

Under direction, supervise and be responsible for the work of a field party in the making of surveys for highway location, construction and maintenance.

Make the necessary computations, sketches and studies for the proper prosecution of the field work.

Make estimates and reports.

Provide for proper organization, subsistence and transportation of field party, when necessary.

Good command of the English language.

KNOWLEDGE:

Care and adjustment of all surveying tools and instruments used by field party.

Field methods of highway location, construction and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, field astronomy, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, and location, construction, and maintenance of highways.

PERSONAL:

Good physical condition and endurance.

Tact, good judgment, and ability in the handling of men.

MINIMUM SPECIFICATIONS FOR MAINTENANCE ENGINEER (HIGHWAY ENGINEERING GROUP)

SKILL:

Under direction, to supervise and direct the maintenance of highways in a district or division.

Direct, in a general way, the work of engineers, patrolmen, inspectors, clerks, and others engaged in maintenance work.

Act as advisor and arbiter on maintenance and related problems.

Make, or supervise the making of, the necessary estimates, schedules, charts, reports, etc.

Good command of the English language.

KNOWLEDGE:

Methods, systems, materials, machinery and tools used in highway maintenance.

Economics of highway operation and maintenance.

Wage rates, labor conditions, purchasing methods and material costs.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, materials of construction, electrical machinery, theory of structures, structural and concrete design, cost accounting, business law, economics, and highway construction and maintenance.

PERSONAL:

Administrative and supervisory ability.

Good physique and endurance.

Tact and good judgment in handling human and technical problems.

Ability to make or supervise the making of analytical studies such as traffic censuses, etc.

Keenness and accuracy in observation.

Firmness and fairness in decision.

Rack-Rail Traction Abandoned

Replacing rack-rail locomotive traction by heavy adhesion engines operating on grades of 6.6 per cent is a notable change reported as being made on the Halberstadt-Blankenburg Ry., in Germany, which was one of the first railways built with the Abt multiple-rack type of rack rail. Tank locomotives of the 2:10:2 type, now being introduced for adhesion working, weigh about 100 tons, with 75 tons on the driving wheels. To facilitate passage of curves of 984 ft. radius, which occur on maximum grades, the middle or main driving wheels have plain flangeless tires, while the second and fifth axles have considerable lateral play in the boxes.

Equipment Rental and Depreciation Record Cards

Financial History of Permanent Plant Easily Kept—Schedules Operate on Basis of Eight Months to Rental Year

TWO cards record the financial history of permanent equipment employed in construction operations by the Henry W. Horst Co., Rock Island, Ill., general contractors. Equipment units having a value in excess of 100 and a normal life of more than one working season are classed as permanent. All equipment consisting of numerous small pieces, as pipe or road forms, and all small tools, as picks and shovels, are charged directly to the job and the job is credited with any salvage value they have. Permanent equipment is not charged to any job but jobs on which it is used pay a rental based on the life of the unit.

Rental Schedules—Equipment generally has a life of three working seasons but there are units, as light motor trucks, which depreciate faster and other units, as hoists, which last longer. Two-, three- and four-year rental schedules are, therefore, employed as follows:

On equipment whose life is 24 months, there will be charged over a two-year period a total of $\frac{19}{20}$ of the original cost, divided as follows: First year, $\frac{9}{20}$ of the purchase price; second year, $\frac{10}{20}$ of the purchase price.

On equipment whose life is three years, there will be charged a total of $\frac{19}{20}$ of the purchase price, divided as follows: First year $\frac{5}{20}$; second year, $\frac{7}{20}$; third year, $\frac{7}{20}$.

On equipment whose life is four years, there shall be charged a total of $\frac{19}{20}$ of the puchase price as follows: First year, $\frac{4}{20}$; second year, $\frac{5}{20}$; third year, $\frac{5}{20}$; fourth year, $\frac{5}{20}$.

These schedules operate on the basis of eight months to the rental year, the rental year usually differing from the calendar year in that most equipment is purchased during the spring or summer and so is not likely to be in operation for eight months in the calendar year of its purchase. The first year basis of rental continues until the piece has seen eight months of service at which time it goes into its second rental year, the change in rental rate applies, and so on. Thus a piece of equipment costing $1,600 and having a life of 2 years would pay in its first year's rental, $800 or $100 a rental month. This piece, if purchased July 1 and used through November, would earn for 5 months' service $500. If next put into service March 1 of the following calendar year and continued through the summer it would earn at the same rate through May, thus completing the eight months of service comprising its first rental year. With June, however, it would enter upon its second rental year and the rental rate would automatically change as per schedule.

Records of the equipment service and earnings are kept on one card for the job summary and another card for the equipment unit. Both cards are kept in one file.

Equipment Unit Card—An equipment unit card containing the financial history of one machine is shown by Fig. 1.

The upper part of this card is largely self-explana-

Equipment: XYZ Loader — Eqp. No. H-432 — Card No. 800

Purchased From XYZ Co.-Chicago, Ill. — Date 3/28/20 — Invoice No. X-4172

Purchase Price $2400. — Terms $2100.-30 days — Trading Credit $300.

Details: Old XYZ loader turned in for $300. credit

Final Disposal: Sold 3/1/22 to A.B.C. Co. for $450.

Transferred from	Date	Transferred to	Date	Recorders Initials
Chicago	3/29/20	Beaver Dam Job	4/1/20	H.M.
B-Dam	12/1/20	Central Storage	12/6/20	T.R.
C-Stor.	3/1/21	Cedar Rapids Road	3/5/21	T.R.

Gain — Loss

Life in Mos.	Original Value	Deprec'n Rate	Rent Rate		Original Value	Deprec'n Rate	Rent Rate		Original Value	Deprec'n Rate	Rent Rate
24	2400.—	100.—	240.—	1921	2400.—	100.—	240.—	1922	2400.—	100.—	
Mo&Yr x 1920	Inventory xx	Dep. Total	Rent Total	Mo&Yr 1920	Inventory	Dep. Total	Rent Total	Mo&Yr	Inventory	Dep. Total	Rent Total
Mar. 20	2400.	—	—	Fwd.	1500.	900.	1680	Fwd	300.	2100.	2760
Apr. "	2300.	100.	240	Jan 31	1400.	1000.	Storage	Jan.	200.	2200.	Not used
May "	2200	200.	480.	Feb	1300.	1100.	"	Feb.	100.	2300.	" "
June "	2100.	300.	720.	Mar.	1200.	1200.	1920		Sold		
July "	2000.	400.	960.		Second rental year.						
Aug. "	1900.	500.	1200.		New rate $120. a mo.						
Sept "	1800.	600.	1440.	April	1100.	1300.	2040.				
Oct. "	1700.	700.	1680.	May	1000.	1400.	2160.				
Nov "	1600.	800.	Not used	June	900.	1500.	2280				
Dec "	1500.	900.	Storage	July	800.	1600.	2400.				
				Aug.	700.	1700.	2520.				
				Sept.	600.	1800.	2640.				
				Oct.	500.	1900.	2760				
				Nov.	400.	2000.	Not used				
				Dec.	300.	2100.	" "				

x Inventory is taken at end of month
xx All equipment is entered in inventory in even dollars

FIG. 1—RENTAL AND RECORD CARD FOR EACH EQUIPMENT UNIT

tory. As indicated, the equipment is numbered and the cards are numbered. The card is kept in file under the job on which the particular piece of equipment is in use. When the equipment is transferred from this job to another job, or to the central storage, it is indicated together with the date and the initials of the recorder in the upper right hand section of the card. This means, of course, that the card is moved about from time to time and that the cards are not kept in numerical order in the filing case. However, each card number is recorded in numerical order on an equipment index sheet, which includes also after the card number, the invoice number, the name and brief description of the equipment, the number given this piece of equipment in the scrap book (in which scrap book are pasted pictures of the equipment) and, in the last column, the final disposition of the piece and date. The equipment cards are checked against this equipment index once a month in order to make sure that all cards that are not in the equipment file have been disposed of in the dead file of worthless equipment and sold equipment.

collected, et cetera. The piece of equipment recorded on the accompanying card is shown as sold for $450 when the book value stood at $100, hence a record of gain of $350. At this point the record is made in the equipment index and the card is removed from the live file to the dead file.

Colored metal tags are used on the cards: Red for general building equipment, blue for road building equipment, orange for automobiles and black for general office. Any piece of equipment not in use by the department owning it may be used by another department but the rental is credited to the earnings of the department owning the equipment.

Job Card—A filled-in job or contract card is shown by Fig. 2. This card shows the sum total of equipment rental paid each month during the life of the particular job or contract and also the depreciation on the same equipment and the "gain" or "loss" to date in equipment rental over or under depreciation. There is also shown the new equipment purchased on any job or contract with additional information sometimes needed.

Job Contract CK4 Rockford — Date Opened 4-2-21 — Date Closed 6-4-22 — (Space for metal celluloid Index Tag)

Mo. and Year	Equipment Rental	Deprec'n	Gain to Date	Loss to Date	Remarks:	Mo. and Year	Equipment Rental	Deprec'n	Gain to Date	Loss to Date	Remarks:
4/21	1040.	730.	310.	—	Forward →	1921	7700.	5860	1840.		
5/21	1040.	730.	620.	—		1922					
6/21	1110.	770.	960.	—		Jan.	—	540.	1300.		
7/21	1110.	770.	1300.	—		Feb.	—	540.	760.		
8/21	1000.	700.	1600.	—		Mar.	400.	540.	620.		Began March 15, 1922
9/21	800.	540.	1860.	—		Apr.	750.	500.	870.		
10/21	800.	540.	2120.	—		May	700.	500.	1070.		
11/21	800.	540.	2380.	—							
12/21	—	540.	1840.	—	Closed 12/1/21 for winter						
Totals	7700	5860	1840			Totals	9550	8480	1070		

New Equipment Purchased	EqpNo.	Purchased from	Date	Pur. Price	Credits	Why Credits	On Inv'tory, at
1 Small XYZ Mixer	H417	A.H.Co. – Chicago	5/20/21	$700.	None	—	$700.00

FIG. 2—RECORD CARD FOR EQUIPMENT ON EACH JOB

Should a card be lost, the loss is discovered by this check within a month's time and while it is still possible to get most of the information back on a duplicate card. Each card is divided below into three sections provided for a record of three years, and the card is a tumble card, that is, it is perforated above and below and in case the equipment is in use more than three years, the card can be turned over and the record carried on the reverse side, which is printed just as is the obverse side. One card will therefore cover a six-year period. It will seldom be necessary to use more than one card for any one particular piece of equipment. Instead of twelve lines for recording the monthly values, there are sixteen lines allowing one line for such notation as is recorded midway in the second calendar year of the accompanying card, Fig. 1, as "Second Rental Year." Note that a piece of equipment remains in its first rental year until eight months rental at a definite rate have been collected and in its second rental year until eight months rental at a different rate have been

These cards have the large celluloid indices under which appear the name of the job or contract and the corresponding index number. A card so indexed is then used at the head of each job and thus serves the double purpose of a job equipment summary and a job index card.

Helping to Improve the Car Situation

There are three ways in which engineers and contractors can help the American Railway Association in its program to maintain the supply of cars. Briefly they are: (1) Anticipate your requirements for bulk material and heavy equipment and place your orders early so that every ton of material that can be moved before fall will be; (2) release your cars promptly, don't wait until the free time is up; (3) when loading material or equipment plan the loading so that each car will have its full capacity and have everything ready for loading when the cars are placed.

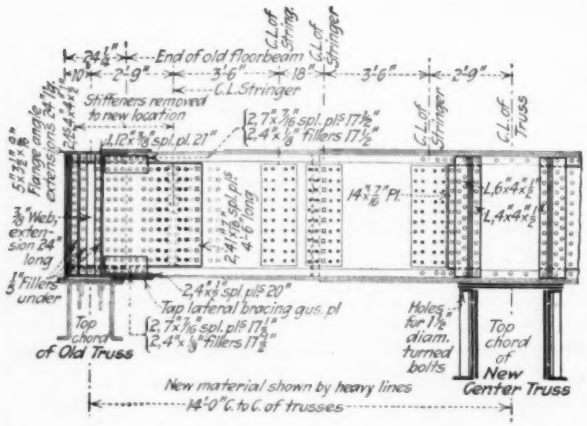
Railroad Bridge Widened and Reinforced

By G. H. Wilsey
Union Station, St. Paul, Minn.

RELOCATION of a part of the Northern Pacific Ry. line in Minneapolis has made necessary the reconstruction of the railway's bridge over the Mississippi River on a new site. The new bridge is being built for modern traffic loads, three-fourths greater than the designed capacity of the old bridge. The main spans of the old bridge are used in the new structure, however; they are being widened, a third truss is being added and the floor is being reinforced, as briefly described in the following.

The railway right-of-way passes through the center of the campus of the University of Minnesota, on the east bank of the river. Under an agreement with the regents of the university the company has relocated its line to the north of the campus, parallel to the Great Northern Ry. line, and the bridge, west of the university, has been relocated to suit.

The new bridge consists of three 90-ft. plate girder approaches on the west, two 245-ft. deck truss spans (the old ones moved to the new location and reinforced


End of old floorbeam
C.L. Stringer
Stiffeners removed to new location
Top chord of Old Truss
Top lateral bracing gus. pl
Holes 7/8" for 1 1/2" diam. turned bolts
Top chord of New Center Truss
New material shown by heavy lines
14'-0" C. to C. of trusses

EXTENDED FLOORBEAM AND NEW CENTER TRUSS SUPPORT DOUBLED STRINGERS

for heavier loading), and two 76-ft. plate-girder spans on the east approach. The plate-girder spans are supported on concrete piers and in order to obtain good proportion in high piers and relative short spans the piers have been made narrow, with heavy reinforcement for traction.

The most interesting part of the work is the reinforcement of the old truss spans. The bridge was designed in 1891 and is a double-track structure with two 245-ft. pin-connected trusses in each span, 24 ft. apart center to center; the floorbeams rest on top of the top chord, and two stringers under each track framed into them were designed to carry 112-ton locomotives, or about E 30 loading. For a number of years traffic has been limited to freight-switching operations and low-speed passenger traffic of the Minneapolis & St. Louis Ry., a tenant line, the passenger traffic of the Northern Pacific going over the tracks of the Great Northern Ry. between St. Paul and Minneapolis.

In the new location the old trusses will be separated to 28 ft. center to center, the tracks being 14 ft. on centers. The old floorbeams will be sent to a bridge shop and extended 2 ft. on each end as shown in the drawing, the stringers of the old bridge will be doubled up under one track, and two new stringers will be placed under the other. A new riveted truss will be placed under the center of the floorbeams.

It is unusual for a pin-connected span to be reinforced by the addition of a riveted truss; but it was held that additional stiffness would be secured in this way without the addition of heavy transverse bracing, as is the custom in the Northwest. The new truss is designed for the standard Northern Pacific loading, equivalent to E 52, and is calculated to carry five-eighths of the load on both tracks. Theoretically the floorbeam reaction of this truss is greater than five-eighths, but the specifications permit of reducing the calculated load 8 per cent for two tracks and the bridge is approached by 8-deg. curves on each end, which will reduce the speed of trains to below that taken into consideration in determining the impact formula of the specifications. The new truss will be erected a small distance below the bottoms of the floorbeams and the latter will be brought to bearing by shimming after the trusses are swung, thus taking care of any permanent set that may be found in them. A new lateral system will be added.

The work has been designed and will be constructed under the direction of H. E. Stevens, chief engineer of the Northern Pacific Ry., and M. F. Clements, bridge engineer.

Friction Spark Set Off Gas Explosion at Springfield

AFTER an investigation of the purifier house explosion at the gas plant of the Springfield Gas Light Co. on Feb. 1, 1923, the Department of Public Utilities of Massachusetts has just reported that gas which leaked from one of the purifier boxes was ignited by a friction spark produced in the attempt to turn a valve which controlled the flow of gas to the boxes. This valve worked very hard, and pipe extensions were slipped over the wrench handles by which the valve was turned. Five men were trying to turn the extended handles, and were making an extra effort to turn it just at the moment the explosion took place. The spark may have occurred in the handle or under the foot of a workman; the men wore shoes with nails in the soles. Prior theories that a spark from the switches of an electric elevator set off the gas were found on investigation to be untenable. The gas leakage was due to the fact that the water seal of one of the purifier boxes was not adequate for the pressures developed under normal working conditions, and a slight increase of pressure due to refilling several retorts is considered to have caused the seal to overflow and gas to escape from the box. Among the recommendations of the department as the result of its investigation are that employees working in inclosed purifier houses be required to wear rubber-soled boots or shoes free of nails, and that all purifier units be controlled by devices which will permit the gas to be shut off easily by one man. It also recommends that where hoisting machinery or elevators are used in a purifier house, other than electric power be employed if possible.

A Logical Method of Computing Motor-Vehicle Fees

Fees in Different States Show Great Inconsistency of Present Practice—Fee Based on Impact Is Proposed

By Robert C. Barnett
Economic Engineer, Jefferson City, Mo.

A LOGICAL basis has not yet been reached for determining automobile license fees. Table I shows the present conditions or factors forming the several different bases which the different states use in arriving at their respective fees. Table II sets forth for each state in the Union the fee that is charged for a 5-passenger Ford and that for a 7-passenger Cadillac. We are groping after a result rather than proceeding by a logical analysis to arrive at a rational basis for assessing a tax.

TABLE I—BASIS OF MOTOR VEHICLE REGISTRATION FEES IN THE DIFFERENT STATES

Basis of Fee	Number of States—Passenger Cars	Number of States—Trucks
Gross weight	9	12
Horsepower	26	2
Horsepower plus weight	5	4
Flat rate for electrics	10	..
Cubic inches piston displacement	1	..
Value plus weight	3	2
Flat rate plus weight	1	..
Horsepower plus value	1	..
Valve only	1	..
Flat rate only	1	..
Tons capacity	..	25
Horsepower plus capacity	..	2
Total tire width	..	1
Chassis weight	..	1

Any readjustment of license fees should be made on a logical basis. Such a basis is to be found in the conception that the total of fees should bear some relation to the *annual cost* of the system and the first cost of construction. Annual cost is the sum of three items, Interest + Maintenance + Sinking Fund Payment. To meet this annual cost, there is needed a perennial source of revenue. Recourse is had to the license fees paid by the motor vehicle owners. As the total of these fees should equal all or a major portion of the annual cost of the highway system, the real problem at hand is to secure an equitable distribution of such fees among the motor owners according to the wear each produces on the roads.

The cost of maintenance depends on the destructive effect of the traffic as likewise does the sinking fund needed to replace the wearing surface.

Investigations carried on by the Bureau of Public Roads reveal the fact that impact is the most destructive agency affecting our highways today.

Impact can be decreased by keeping the road surface smooth, in short, by a thorough maintenance of the road surface. Impact is lessened by reducing the weight of the unsprung parts of the vehicle—that is the wheels, housing, differential gears, and axle. Impact is also diminished by the resiliency of the tires and of the wearing course of the pavement. It is increased by the load above the wearing course of the pavement. It is increased by the load above the springs. Impact increases with the speed of the vehicle to some extent.

Speed depends upon the horsepower of the motor and decreases as the road resistance increases, or as the load and tractive resistance increase.

Condensing these statements of relationships, we have:

1. Impact varies as

$$\frac{\text{(Load above springs) (Weight unsprung parts) (Speed)}}{\text{Resiliency of Tires}}$$

2. Speed varies as

$$\frac{\text{Horsepower}}{\text{(Weight vehicle, loaded) (Tractive resistance)}}$$

As tractive resistance is not dependent upon the vehicle, it need not be considered here as it will later be absorbed in the general constant that will appear in the final equation. Substituting the value for speed in the above expression, we have.

3. Impact varies as

$$\frac{\text{(Load above springs)}}{\text{(Weight vehicle, loaded)}} \times \frac{\text{(Weight unsprung parts) (Horsepower)}}{\text{(Resiliency of tires)}}$$

TAPLE II—COMPARISON OF AUTOMOBILE REGISTRATION FEES FOR THE VARIOUS STATES

State	Five-Passenger Ford	Seven Passenger Cadillac
Alabama	$11.25	$26.25
Arizona	5.00	10.00
Arkansas	9.25	15.65
California	8.80	12.40
Colorado	5.00	5.00
Connecticut	14.10	18.90
Delaware	8.40	19.60
District of Columbia	3.00	10.00
Florida	10.50	24.50
Georgia	11.25	19.60
Idaho	20.00	40.00
Illinois	8.00	12.00
Indiana	5.00	8.00
Iowa	10.00	47.60
Kansas	8.00	13.75
Kentucky	13.20	18.60
Louisiana	15.00	21.10
Maine	10.25	17.75
Maryland	13.20	18.60
Massachusetts	10.00	15.00
Michigan	10.75	18.75
Minnesota	12.00	15.00
Mississippi	11.00	15.50
Missouri	7.00	11.00
Montana	7.50	15.00
Nebraska	10.00	15.75
Nevada	7.35	17.15
New Hampshire	12.60	29.40
New Jersey	8.80	15.50
New Mexico	8.80	12.40
New York	7.10	20.35
North Carolina	12.50	30.00
North Dakota	7.20	26.85
Ohio	8.00	12.00
Oklahoma	10.00	29.90
Oregon	15.00	55.00
Pennsylvania	8.80	12.40
Rhode Island	10.75	20.00
South Carolina	6.00	10.60
South Dakota	6.00	6.00
Tennessee	11.00	15.50
Texas	7.70	10.85
Utah	10.00	15.00
Vermont	22.00	31.00
Virginia	13.20	19.60
Washington	10.00	25.15
West Virginia	12.90	24.00
Wisconsin	10.00	10.00
Wyoming	8.00	16.00
Average	10.02	18.98

In all equity, the vehicle should be penalized according to the damage that it does to the roads. In other words, the owner should pay according to his ability to produce the maximum impact with his particular car. We have here a logical basis for determining license fees by making such fees vary according to the possible impact that the specific vehicle can produce. By introducing a general constant in our expression for impact, we can put the general relation in the terse language of an equation.

$$\text{License Fee} = \frac{\text{(Constant) (Load above springs)}}{\text{(Weight vehicle, loaded)}} \times \frac{\text{(Weight unsprung parts) (Horsepower)}}{\text{(Resiliency of tires)}}$$

To illustrate the application of this equation, let us assume some approximate values for the total license

fees required and for the average motor vehicle, and then determine the value of the general constant and subsequently the license fees for several different cases.

Assume:	
Total license fees required	$6,000,000
Weight of loaded vehicle	3,000 lb.
Weight above springs of rear axle ($\frac{1}{2}$ of total load less unsprung)	1,600 lb.
Weight of unsprung parts rear axle	500 lb.
Horsepower of motor	30
Resiliency of worn solid tire	1
Resiliency of pneumatic tire (Bureau of Pub. Roads data)	7
Total number of vehicles (10 per cent of which have solid tires)	350,000
Weighted average resiliency then becomes	6.4

Substituting these numerical values in our equation, we have

$$\frac{6,000,000}{350,000} = \frac{(\text{Constant}) \times 1,600 \times 500 \times 30}{3,000 \times 6.4}$$

Solving this and thereby determining the value of the general constant, we find

$$\text{Constant} = \frac{6,000,000 \times 3,000 \times 6.4}{350,000 \times 1,600 \times 500 \times 30} = 0.0137$$

For the assumed conditions, the equation for any specific car becomes

$$\text{License Fee} = \frac{0.0137\ (\text{Load above springs})}{(\text{Weight vehicle loaded})} \times \frac{(\text{Weight unsprung parts})\ (\text{Horsepower})}{(\text{Resiliency of tires})}$$

For the hypothetical average car as assumed, the license fee as determined by our equation is very nearly $16.

For a Ford touring car, our values would run as follows:

Weight of loaded vehicle	2,500 lb.
Weight above springs	1,450 lb.
Weight of unsprung rear axle	300 lb.
Horsepower of motor	25
Resiliency of tires	7

Using these values, our equation becomes

$$\text{License fee} = \frac{0.0137 \times 1,450 \times 300 \times 25}{2,500 \times 7} = \$8.50$$

For a 3-ton truck with pneumatics, we have as approximate values:

Weight of loaded vehicle	12,000 lb.
Weight above springs	7,200 lb.
Weight of unsprung parts	1,200 lb.
Horsepower of motor	35
Resiliency of tires	7

With these latter values, our equation now becomes

$$\text{License fee} = \frac{0.0137 \times 7,200 \times 1,200 \times 35}{12,000 \times 7} = \$49.30$$

If this truck were equipped with solid tires, the fee would amount to 7 × $49.30 or $345.10 unless the owner could be made to replace the solid tires before they became badly worn.

For a 5-ton truck with solid tires, we would have as approximate values:

Weight of loaded vehicle	20,000 lb.
Weight above springs	12,000 lb.
Weight of unsprung parts	2,000 lb.
Horsepower of motor	45
Resiliency of tires	1

These values substituted in the equation give a fee of $739.80.

It is thus seen that the equation gives reasonable values for cars which do small damage to the roads and that for large trucks with bad tire conditions the fee becomes a sufficient deterrent to keep them off the state roads or compel the owners to replace the worn-out tires.

An Unusual Series of Intense Rainfalls

By J. H. Lance
Consulting Engineer, Wilkes-Barre, Pa.

As demonstrating that no long period need elapse between such storms, and particularly as emphasizing the wisdom of the utmost despatch in executing repairs to inadequate structures which may have been injured by flood lest damage pile on damage, the series of severe rainfalls which occurred in the Lackawanna Valley of Pennsylvania during the summer of 1922 is of interest. These storms, the limits of which are approximately shown on the accompanying map, occurred on June 3, 11, 17 and 20, July 1, 2 and 28. None of them except that of July 28 attained its maximum intensity over a Weather Bureau station, consequently it was necessary to rely in most cases upon local observers for time-depth measurements of the rainfall.

June 3: This flood was most severe to the north of Carbondale. Wilson Creek, with a drainage area of 3.4 sq.mi., reached a maximum rate of runoff of about 300 sec.-ft. per square mile, and Fall Brook, with 11.4 sq.mi., about 146.

June 11: Most of the damage was done by wind, and the rainfall, while severe, was of short duration.

June 17: The storm reached its maximum intensity at Carbondale and directly east and west therefrom. The rainfall on Fall Brook amounted to 4.3 in. in 4.3 hr., and the resultant runoff reached a maximum rate of about 200 sec.-ft. per square mile. The same rate would have obtained on Racket Brook but for the ponding effect of the Brownell reservoir of the Consolidated Water Supply Co., which reduced the maximum flood rate at that point from about 140 sec.-ft. per square mile to about 55, and delayed it about four hours.

June 28: On the Fall Brook watershed, where the storm was most intense, the precipitation was 3.25 in. in 2 hr., and the resulting runoff reached a maximum rate of about 160 sec.-ft. per square mile.

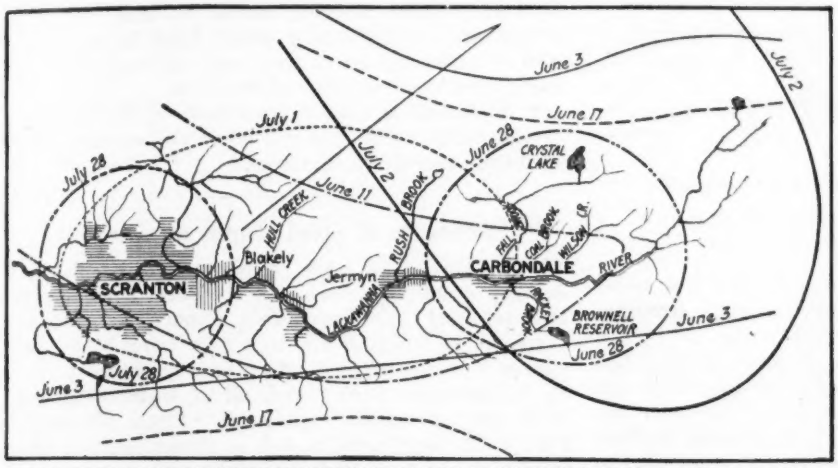
July 1: This was a rainfall of short duration but great intensity. No record of the amount was found, but violent floods were caused on Hull Creek in Blakely and Rush Brook in Jermyn, and the intervening smaller streams. Hull Creek reached a maximum discharge rate of more than 120 sec.-ft. per square mile, and Rush Brook slightly less.

July 2: The whole upper drainage area of the Lackawanna River, in addition to over 100 sq.mi. of that of Tunkhannock Creek, adjacent on the west, was visited by an unusually intense rainfall. In 75 min. 2.75 in. fell on the Fall Brook drainage area, though the most intense precipitation appears to have occurred a little to the northwest. Fall Brook reached a maximum runoff rate of about 270 sec.-ft. per square mile. The maximum attained on Racket Brook was equal to that of June 17. The Lackawanna River overflowed its banks throughout Carbondale and downstream therefrom, destroying a concrete bridge in Mayfield by undercutting of the abutments and the single stream pier —which seemed to have been founded on the deposit of coal waste and sand to be found in the beds of most streams in the anthracite mining region.

July 28: This storm occurred directly over Scranton, where there is a United States Weather Bureau station. The rainfall amounted to 1.91 in. in 1 hr., which intensity is said to have been equalled only once in the twen-

ty-two years' previous history of the Scranton station.

The Principal Lessons to be learned from a study of these storms, which caused damage amounting to about $4,000,000, are that it is unsafe to rely upon protection against any but a maximum flood, even for works of a temporary nature; and that maximum floods may occur in any year or at any interval. Thus, taking Fall Brook as a guide (because better opportunities were there afforded for accurate flow measurements), the flood of June 3 was said by observers to have been the greatest in about twenty years; yet that flood was exceeded three times in the next thirty days, the last time by about 85 per cent. In addition, there may be created a great variation in the maximum runoff rates on different streams under the same rainfall conditions, due to size and topography of the basins and relative position of the stream branches.



LOCATION OF SEVEN HEAVY PENNSYLVANIA RAINFALLS, JUNE 3-JULY 28, 1922

Loss of Head in Valves and Pipe

Summary of a pamphlet report on experiments at the University of Wisconsin by Charles Ives Corp, professor of hydraulic and sanitary engineering, and Roland O. Ruble, instructor in hydraulic engineering.

1. The loss of head due to valves and other fittings occurs in part within the valve or fitting and in part as an added loss in the pipe line downstream where normal flow has been disturbed.

2. Measurement of the loss of head where the downstream piezometer is attached too near the valve will give a loss in excess of that actually produced. From 20 to 25 pipe diameters beyond the valve will probably give the best position for the downstream piezometer opening. It is undesirable to have a greater length of pipe in the gage length than is actually needed to include all valve loss.

3. The loss of head in new clean wrought-iron pipe from ¼ to 12 in. in diameter is given approximately by the formula $H = \frac{0.0319}{d\ 1.16}\ v\ 1.9$ in which H equals loss of head in feet per 100 ft. of pipe, v is the velocity of flow in the pipe in feet per second, and d is the pipe diameter in feet.

4. Globe valves offer from 15 to 40 times the resistance of gate valves for the same size. This ratio increases with the increase in the size of valves.

5. The length of straight pipe of the valve size which will produce the same loss of head varies from ¾ to 4 ft. for fully open gate valves and from 20 to 35 ft. for fully open globe valves. In the case of globe valves the smaller valves are equivalent to the greater length of pipe measured in pipe diameters.

Points on Bridge Maintenance

IN A paper urging more thorough inspection and more effective maintenance of highway bridges, read before the Minnesota Engineers and Surveyors Association last month, E. J. Miller made some suggestions for maintenance and gave valuable data on the cost of painting and floor repair. Adequate painting, if done once in five years, should be effective in protecting steel bridges from deterioration, and this will be accomplished at a cost of 20 to 25c. per lineal foot of bridge per year.

Costs derived from the repainting of 107 bridges totaling a length of 10,824 ft. show the cost of cleaning and painting, including the cost of painting and the rental of equipment, to have averaged 99c. per lineal foot of bridge. As to methods, Mr. Miller said:

On construction the bridges in Minnesota receive one shop coat of red lead and one field coat of graphite paint. These structures should receive their next coat of paint before the red lead is uncovered. However, most steel bridges in the past have been left to deteriorate until even most of the red lead has disappeared. Such cases should be either spot-coated with red lead, or, if all the original red lead has disappeared, should receive a first coat of paint. It costs in the neighborhood of $6 or $8 per gallon for labor in painting steel bridges. Therefore, it is an easy deduction that the longest-lived paint is the most economical. We have made a practice of preparing steel surfaces for painting by thorough scraping, wire brushing and cleaning. The sand-blast method has not been resorted to because it requires a bulky field equipment, is expensive, is no better for the preservation of the steel than thorough cleaning, and because, when deterioration has gone so far that more effective cleaning than scraping and wire brushing is needed, the structure is generally beyond salvage.

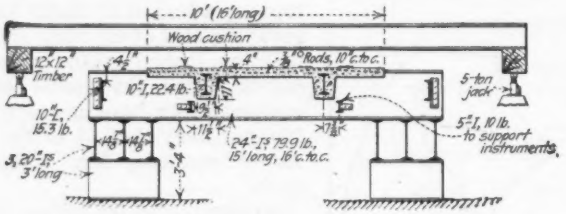
Floor Strengthening—Many bridges in Minnesota that are now inadequate can be made to give long service at moderate cost by carefully planned reinforcement, the author said. A bridge capable of carrying 10 tons safely should not be considered dangerous except on a heavily traveled trunk road, but all lighter bridges should be posted for their safe load capacity. The most common weakness is found in the bridge floor, and frequently this can be removed by substituting a smooth, stiff floor, laying additional stringers or new stringers when needed.

We have had marked success with a new 3-in. or 4-in. subfloor laid diagonally and a new 2-in. oak wearing course laid longitudinally. The life of such new floor may be increased by creosoting the subfloor and by treating the tops of the wooden stringers or nailing strips with brush coats of creosote oil mixed with tar and sanding immediately. If the main structure will carry a heavier floor, a creosoted subfloor and 3-in. creosoted block wearing floor will give excellent and economical service.

The cost of reflooring as described, based on the records of the past year, is $7.82 (including 3 x 12-in. subfloor, 4 x 6-in. wheel guards, 2 x 10-in. longitudinal oak wearing surface, and treatment of subfloor, wheel guards, and top of oak floor). This figure is based on unit prices as follows: 2-in. bridge oak, $54 per M; 2 x 12-in. fir, S1S1E, $56 per M; graphite paint, $1.65 per gallon; red lead paint, $3.60 per gallon.

Tests of Steel Floor Joists With Concrete Encasement

TESTS of two steel floor panels such as would be used in a building were recently carried out at the plant of the Dominion Bridge Co., Montreal, for the steel fabricators' section of the Canadian Manufacturers Association, to determine the effect of the concrete floor slab and beam encasement in reducing the stresses in the steel and thereby increasing the carrying capacity of the floor. The conclusion was reached that the concrete reduces the steel stress by about 36 per cent under dead- and full live-load. With a live-load 50 per cent



CROSS-SECTION OF TEST PANEL WITH CONCRETE SLAB AND BEAM ENCASEMENT

above normal the steel stress was 20 per cent lower than under full live-load in a panel without the strengthening action of the concrete, and even twice the normal live-load resulted in a lower flange stress in the steel beams than was produced by normal live-load in the panel without concrete encasement. In these comparisons, the dead-load was the same in both cases, the load on the panels without encasement being made equal to the total dead- and live-load on the concrete-encased panels. Thus, the results indicate what proportion of the strength of the finished panel is ignored when the strength calculation is based on the resistance of the steel beams alone, as is now current practice.

Two identical test panels were built, each 15 x 16 ft., composed of a 24-in. I-beam 15 ft. long on each side, as floor girders, and two 10-in. by 22.4-lb. I-beam joists framed into the webs of the girders with span of 16 ft. and spacing of 5 ft. The ends of the 24-in. I-beams were connected by 10-in. by 15.3-lb. channels. Two 5-in. I-beams just below the joists provided supports for strain gages. In the first part of the tests, loads were applied direct to the steel panel, which was supported on grillages under the girders at the four corners; in the second part of the tests a 4-in. reinforced-concrete floor slab 10 x 16 ft. was constructed in the middle part of the panel, over the two joists. The slab concrete was carried down around the joists to a depth of 2 in. below the bottom flanges, with a bottom width of 9½ in. and a top width (at under side of slab) of 11½ in.

The slab thus represented normal construction for a width of two 5-ft. panels. The steel weight (joists only) represented 4½ lb. per square foot of floor, and the concrete weight 71.9 lb. per square foot of floor, a total of 76.4 lb.

Before concreting, stress and deflection measurements were made under loads of about 75 lb. per square foot and 185 lb. per square foot, the latter representing a 110-lb. live-load combined with full dead-load (taking account of the weight of the concrete floor). The measured stresses in the joist flanges agreed closely with the calculated stresses of about 6,300 and 15,500 lb. per square inch respectively, showing the general reliability of the method used.

After the concrete had been poured and allowed to set for 23 days, the flange stresses in the beams were again measured, and were found to check the results on the bare panels under a load corresponding to the concrete load, when allowance was made for the extra weight of the forms. Tests were then made under superimposed live-load of 110, 165, and 220 lb. per square foot. The live-load flange stresses in the joists under these loads were found to be 2,750, 5,100, and 7,600 lb. per square inch respectively. The combined dead- and live-load stresses therefore were: For full live-load, 9,530 (as against 15,500); for 1½ times full live-load, 11,880; and for double live-load, 14,380 lb. per square inch, which is about 1,000 lb. per square inch less than the stress with only half as great a live-load in the bare condition of the panel.

It is planned to make further tests on the two panels to see whether vibration will affect the strength of the steel-and-concrete combination.

Strength of Steel Ropes on Sheaves

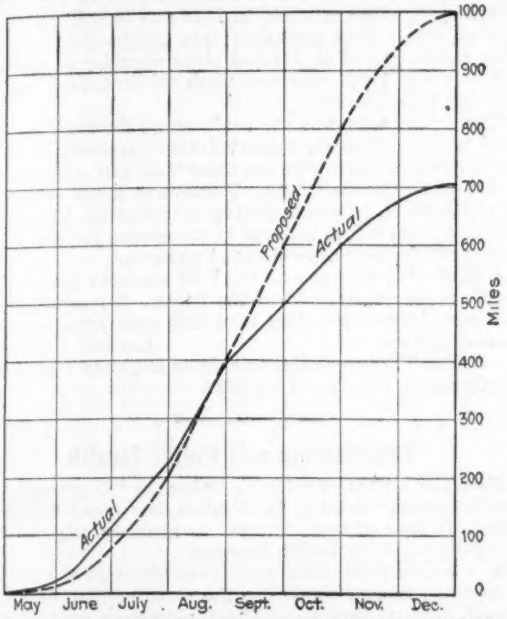
IN A SERIES of tests on plow steel wire hoisting ropes recently carried out by the Bureau of Standards and reported in "Technologic Paper" No. 229, the reduction of strength due to a rope being bent over a sheave was specially investigated. Ropes of ⅜ in. to 1¼ in. diameter were tested, all of them being 6x19, with jute or manila rope cores. Pieces of straight rope 6 ft. long were tested in direct tension, while for the sheave tests 12-ft. lengths were passed over two sheaves attached to the head and their ends connected by turnbuckles attached to sockets. The test results were quite consistent. The straight rope showed fairly uniform efficiency (strength of rope divided by aggregate strength of wires) of about 85 per cent. The efficiency of the rope bent over sheaves ranging from 10 in. to 18 in. in diameter, based on the strength of the straight rope, ranged from 96 to 76 per cent, showing regular decrease as the ratio of size of sheave to size of rope decreased. Rated on the basis of the strength of the wire, the strength of the rope on sheaves ranged from 82 to 66 per cent. The wire of these ropes had a tensile strength of about 230,000 lb. per sq.in., with elongation about 2 per cent in 8 in., and reduction of area about 46 per cent. In agreement with previous test results it was found that the tensile strength of the straight rope may be expressed by the formula $83{,}000d^2$, where d is the diameter of the rope in inches.

All of the rope tests showed a bend in the load-elongation curve at about two-thirds the ultimate strength. Below this point the modulus of elasticity (based on total, not on elastic, elongation) was about 8½ million pounds per square inch. High loads were found to have a decided effect in compressing the rope core and squeezing out of the lubricant contained in the core, and the report states "the one heavy load would squeeze out more of the lubricant from the interior of the rope than the working load applied many times. This lubricant cannot be easily replaced. Under the ordinary working load the lubricant would be squeezed out very slowly even if the load were to be repeated a great many times."

Ohio Highway Mileages in 1922

By J. Perry Shumaker
Chief Engineer, Bureau of Construction,
Ohio Department of Highways and Public Works, Columbus, O.

A SIMPLE diagram of paved road construction in Ohio in 1922 brings out clearly the effect of strikes and embargoes on progress. When the construction season opened in 1922 the Bureau of Construction found that it had 330 miles that had not been accepted during the previous year. After checking up on the amount of money that was available for 1922 it was determined



ROAD CONSTRUCTION PROGRESS IN OHIO IN 1922

that the total miles under construction would be around 1,000 miles. The total actual miles were 1,044.

Before a graph was drawn it was necessary to know the status of the 330 miles carried over and how early new work could be gotten under contract. April 15 was selected as the average date of all highway awards for the year, but what actually happened was that May 15 became the average date and this retarded the actual completion.

The Department was able to keep up with the proposed mileage until Sept. 1. On July 1 the curve of proposed completion had been beaten by 30 miles, on Aug. 1 the work was 20 miles ahead and on Sept. 1 it was four miles behind.

Miller Would Improve Manhattan Traffic

Widening of some streets in the most congested areas, extension and connection of others to provide more north and south traffic lanes, pedestrian subways at points of greatest congestion and the revision of elevated structures and surface lines to provide increased ease in traffic, are essential features of a comprehensive plan for relieving traffic congestion in Manhattan, New York City, made public April 30 by Julius Miller, borough president. Specific streets together with the character of improvement contemplated, are given in the plan which Mr. Miller will soon lay before the Board of Estimate for authority to carry into effect. One of the engineering features involved is the removal to curb lines of columns supporting the "L."

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Steel Stresses and Bad Work

Sir—Accustomed to excellent editorial counsel from the *News-Record*, one feels a distinct shock at reading advice that invites disaster. It is in the last paragraph on page 653:

"The structural profession owes it to itself to place its work on a stress basis free from allowance for bad work, and then to fight hard for elimination of bad work." Let the structural profession eliminate bad work as far as may be, and *then* make such changes in their stress basis as they can justly have a right to make. H. F. Dunham.

New York, April 18.

Tightening a Bridge Member by Heating and Upsetting

Sir—Your issue of Mar. 22 contains an article "Tightening Tension Bars of a Bridge by Heating and Upsetting." It is no wonder to me any more why the general public refuses to recognize engineering as a profession, and classes the bridge engineer with stationary engine drivers, or plumbers, or carpenters. It seems to me that it is high time for the editorial staff of *Engineering News-Record* to apply the microscope of criticism to some of the stuff appearing in its pages.

If a mechanic or a plumber had tightened the tension member of a bridge in the manner described, it could be said with justification that he didn't know any better, but for a technical organization to countenance any such quackery goes beyond the range of patience. All the years of patient teaching, scientific research and careful preparation of specifications are thrown into the discard when such things are done—and called "ingenious." The general public and many young—old, also—engineers without experience see such things published in a publication of the standing and reputation of *Engineering News-Record* and take it for granted that there can be nothing technically wrong with the method; if there was, it wouldn't be published. Having seen, or having read about its being done in one case, on an unimportant structure, he is liable to attempt to do something of the same nature on an important structure, with disastrous results and consequent condemnation of the whole profession by the public.

If you could tighten the tension members of a bridge by any such method as that described, and get away with it, it would be just as logical, just as sensible—or just as ridiculous and absurd—to attempt to shorten the length of a compression member by heating and putting a kink in it. It wouldn't take a bridge engineer or a testing machine to tell what results to expect.

I know of one case where a so-called engineer took the plans for a 75-ft. wooden truss highway span and lengthened it out to 84 ft. in the field, and came back to the office glowing with the feeling that he had done something brilliant. When his action was condemned, he couldn't understand what was wrong, and I do not believe he understands yet what was wrong, although the structure had to be taken down and replaced at heavy expense a comparatively short time afterward. In another case, a so-called engineer in an executive position caused the erection of a structure which he called a Howe truss highway bridge of about 60-ft. span without taking measures to transfer the shear of the web diagonals to the chords. When it failed by sagging soon afterward and had to be repaired at heavy expense to the public, he couldn't understand what was wrong with it, and when told what was wrong with it, in somewhat caustic language, he said: "Well, I only took an hour to design

that bridge, and maybe I did overlook something!" He was told that he had better take two hours the next time.

The question has been asked a good many times in the last few years, what is the matter with the engineering profession? The question is easily answered. It is the engineers themselves. When the time comes that engineers as a whole recognize the undeniable fact that engineering as a profession is an assembly of specialties; that no one engineer is big enough or brainy enough to be any where near proficient in them all; that it is just as criminal for an engineer to attempt to design a bridge, or to monkey with a bridge, without having had the necessary training and experience, as it is for a medical practitioner to attempt to perform an intricate surgical operation without having had the necessary arduous years of training and experience as a surgeon, then and not till then will the engineering profession get on solid ground and be recognized as such. And the whole proposition is solely up to engineers themselves. No layman is going to help them out of the morass or bog.

OLIVER A. HALL,
Designing Engineer, Alaska Road Commission.
Juneau, Alaska, April 12.

Sir—Thank you for the copy of Mr. Hall's comment on my account of the method of tightening the truss diagonals on the Millport bridge over the Muscatatuck river, or heating and upsetting, which you published in your issue of March 22. We of course recognized the possible danger from the method used and took corresponding precautions. The results justified our efforts, to the best of my knowledge and belief. WM. J. TITUS,
Bridge Engineer, Indiana Highway Commission.
Indianapolis, April 23.

The "Mystery" of the Hot Bolt

Sir—A few days ago, when in Atlanta, I was informed that there was a mysterious thing which I ought to see, on a bridge across the railroad near Union Station. It has puzzled the people for some time, and I was told that no one seemed to have any explanation of the phenomenon. The mystery was a bolt at the head of the stairway leading from the railroad track level to the bridge, which was said to be always hot, so hot that one cannot hold the hand on it for more than a second or two.

On the cast iron newel post at the head of the stairs there is a small lug through which a bolt passes. This bolt connects the gaspipe handrailing to the newel post. The location of the greatest heat is in this lug. The bolt passing through the lug is, of course, hot. The lug is almost hot enough to light a match by mere contact. The popular explanation is that the strain on this bolt is excessive. Another is that expansion and contraction cause the heat, by friction. Before seeing the thing I had concluded that the heat was due to stray current from the street car rails on the bridge.

I purchased a combination voltmeter and ammeter and tried this, making contact with the newel post and the hot bolt. The instrument registered twenty amperes of current shunted through it. Of course the current passing through the lug was probably several times as large as this. No doubt the cause is poor bonding of the rails on the bridge and the shunting of the return current, that should go through the rails, through the steelwork of the bridge and into the ground by way of this stairway. The reason for the heat is the high resistance of the small cast-iron lug and the poor electric contact where the bolt passes through the lug.

Other bolts in the connections of the handrailing were found to be warm. The handrailing, near the foot of the steps, turns and connects to a building; possibly it has electric contact with the steelwork of the building.

The only mystery about the thing is why it should have remained an alleged mystery for more than a day. But the case offers a cogent reason for the most careful kind of bonding of trolley rails, especially in the neighborhood of a steel or reinforced-concrete bridge, for powerful effects such as this are apt to work havoc with the strength of a bridge, either by electrolysis, where moisture exists, or by the generation of heat, as in this case, if the point of resistance should be a vital connection. EDWARD GODFREY.
Pittsburgh, April 17.

Old Concrete Road in Mississippi

Sir—The article in *Engineering News-Record*, April 5, p. 619, with regard to a section of concrete road near Mason City, Ia., laid in 1913 and still giving good service, reminds me of a section of concrete road in Lee County, Mississippi, which was laid in 1914 and is still giving good service also. This pavement was constructed 9 ft. wide with a 3-ft. gravel or crushed stone shoulder on each side. The mix was 1:2:3, and wire mesh reinforcement was used in a few places on fills.

The writer who was the engineer on the work when the road was constructed, inspected this pavement about two years ago and there were not more than half a dozen cracks in the whole 12-mile length. Transverse joints were placed at about 30 ft. intervals during construction, and I might add that I am a firm believer in transverse joints and reinforcement for any concrete road pavement.

I think this was one of the first concrete roads of any length to be constructed in the South. My recollection is that one short section had been laid near Atlanta, Ga., at an earlier date. LANDON G. SMITH,
Bridge Engineer, Alabama State Highway Department.
Montgomery, Ala., April 13, 1923.

Engineering and Public Health

Sir—The address by M. N. Baker on "Engineering and Public Health" printed in *Engineering News-Record* for March 15 was of keen interest to sanitary engineers and especially to public health workers.

It is a forgivable since unpreventable fault of specialists in any line to over-emphasize the value of their objectives. Actual accomplishment of these objectives, such, for instance, as removing pollution from streams or cleansing water supplies, has been difficult enough in many cases to warrant some lack of perspective in order that a decently effective program might be put through. But, as Mr. Baker brings out in his suggested definition, engineering should remain engineering and should not be colored by unbalanced enthusiasm or develop into uneconomical propaganda.

Many will recall the courageous action in 1910 of Dr. Porter, then State Commissioner of Health, and Theodore Horton, engineer of the State Department of Health, in approving plans for sedimentation, only, of the sewage of Rochester in the face of protests by a large section of the press, some of the university professors and many of the citizens of that city who seemed keyed up to demand sewage treatment of the *n*th degree. The experience at Rochester since then has amply justified the sound engineering judgment of Messrs. Kuichling, Fisher and Skinner, and the city could at any time, now, if necessary, build extensions to the plant to provide almost any degree of purification with the interest and operating funds saved since the plant was constructed.

The pendulum in sewage treatment has been steadying in recent years but there appears to be some disturbances lately with the danger that several large cities may eventually find themselves unnecessarily overburdened. Such situations do not tend to insure the maximum of progress.

Rational treatment of sewage and the safeguarding of the quality of public water supplies must and will extend rapidly in the near future. The value of such improvements should not be overshadowed but I believe with Mr. Baker that a balancing of budgets to give greater prominence to city planning, proper housing conditions and conveniences for community comfort and recreation is seriously worth while. H. BURDETT CLEVELAND.
New York City, April 20.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Oregon Short Line R.R. Co., has applied to the I.C.C. for authorization to construct a line 27 miles long from Orchard to Perkins in Ada County, Idaho.

The Westinghouse Electric Manufacturing Co. has announced the award to it of a $15,000,000 contract for the electrification of 215 miles of the Virginian Ry. between Roanoke, Va., and Mullins, W. Va.

One Hundred and Fifty-One Miles of second track between Seligman and Needles on the Santa Fe will be opened on May 15 and 69 miles betweed Bagdad and Daggett will be ready by Sept. 1.

Legislation Exempting Engineers and surveyors who are solely officers or employees of a corporation engaged in interstate commerce from the provisions of the general business law for licensing engineers and surveyors, has been introduced into the New York State Legislature.

During the Fiscal Year Ending April 9, 1923, the St. Louis Board of Public Service awarded contracts for public improvements totaling $5,850,569.30 compared with $2,802,757.93 the previous year. During the year 35 public lettings, embracing 214 improvements, were held.

Completion of its Program for Double Tracking from Omaha to Ogden, Utah, during 1923 is planned by the Union Pacific R.R. The road will also make minor extensions, improve existing tracks and buy new equipment; the whole program to call for an expenditure of $40,000,000.

Two Hundred Miles of Double Track will be provided by an agreement which is being made between the Southern Pacific and the Western Pacific railroads. By the agreement this length of parallel single track lines in Nevada will be consolidated into a joint section of double track.

Work Will Start at Once on the elimination of grade crossings in that part of Philadelphia lying south of Christian St., between the Schuylkill and Delaware Rivers, a compact between the city of Philadelphia and the railways operating in South Philadelphia concerning such work having been completed.

A 2,000,000-Bushel Grain Elevator at St. Louis, costing about $1,100,000, is the largest single item in the approved program for improvement work on the Missouri Pacific R.R. during the present year. Next to this comes $927,000 for shops and engine terminal extensions at St. Louis, Mo.; Wichita, Kan.; Ossawatomie, Kan., and Van Buren, Ark. Other improvements involve about $1,500,000.

Secretary of War Allocates River and Harbor Fund

Definite allotment was made April 24 by the Secretary of War of funds for river and harbor improvement provided by the War Department Appropriation Act approved June 30, 1922. Total allotments are $40,463,280. There is reserved for contingencies a sum of $16,126,630. These two sums make up the total appropriation of $56,589,910 provided by the 1923 act. Following is a list of projects each of which will receive more than $500,000:

1.	Ohio River lock and dam construction	$5,000,000
2.	East River improvement, N. Y.	2,700,000
3.	Delaware River, Philadelphia to the sea	2,000,000
4.	Monongahela River, Virginia and West Virginia	1,600,000
5.	Houston Ship Channel, Texas.	1,100,000
6.	Chesapeake and Delaware Canal	1,000,000
7.	Staten Island Sound	1,000,000
8.	Mississippi River, between Missouri River and Minneapolis	900,000
9.	Coos Bay, Oregon	900,000
10.	Columbia and Lower Willamette Rivers	900,000
11.	Savannah Harbor	850,000
12.	Southwest Pass, Mississippi.	800,000
13.	Harbor at Sabine Pass and Port Arthur Canal, Texas.	800,000
14.	Mississippi River between Ohio and Missouri Rivers.	800,000
15.	Waterway, Mississippi River to Bayou Teche	675,000
16.	Wilmington Harbor	600,000
17.	Jamaica Bay, N. Y.	600,000
18.	Los Angeles Harbor	575,000
19.	St. Mary's River, Mich.	550,000
20.	Baltimore Harbor and channels	520,000
21.	St. Johns River, Jacksonville, Fla.	500,000

Am. Soc. C. E. Pledges Support to Building Conference

The American Society of Civil Engineers, through its secretary, on April 20, sent the following telegram to Herbert Hoover, Secretary of Commerce:

"In view of the unusual conditions in the building trades the board of direction of the American Society of Civil Engineers has authorized me to assure you of its sincere wish to be of any service within its power in case you desire to call a conference of representatives of interested organizations which we are advised you are contemplating."

Carquinez Straits Bridge Permit Granted by War Department

The War Department has granted the Rodeo-Vallejo Ferry Co. permission to construct a cantilever bridge across Carquinez Straits between Vallejo and Valona, Calif. This is in accordance with the application noted in *Engineering News-Record* March 22, p. 557. Permission was given to construct the preferred type, a cantilever bridge which calls for a central pier and two 1,100-ft. spans. Work is to be started at once, it is announced, and the completion is expected by July 4, 1925. The cost is estimated at $4,000,000.

Illinois Opinion Divided on Good Roads Issue

Proposed Hundred Million Bond Issue Fought By Commercial Interests —Pay-As-You-Go Policy

Engineering News-Record Staff Report

Good roads advocates in Illinois, formerly working together, are now divided into two camps over the proposed $100,000,000 bond issue. It is an administration measure and as such has assumed political as well as financial and engineering aspects. In general the automobile, banking, financial and large commercial interests are aligned against the state officials, downstate politicians, farmers and residents of the smaller towns, who have become impatient because of the necessary slowness in constructing the 4,800-mile road system authorized, with the $60,000,000 bond issue, in 1918. This is an unusual situation. Commonly it has been the farmer and rural tow taxpayer who this winter has been attacking extended expenditures fo roads. In this instance a definite re action against providing more funds has come from those who are usually keenest for highways—the financial and commercial interests.

Pay-As-You-Go Plan

The bankers, who are leading the opposition, have worked out a pay-as-you-go, 5-year financial program, which, including the $43,000,000 not expended of the $60,000,000, will provide $112,000,000 and build the remaining 3,000 miles yet to be constructed of the original 4,800-mile trunk line system, laid down in 1918. Further, 600 miles of paved road can be constructed annually, about the maximum, the bankers feel, which can be constructed without seriously clogging transportation facilities and material production and without interference with both farm and industrial labor. In respect to the fact that the proposed $100,000,000 issue contains $70,000,000 for additional mileage to the system, as now laid out, the bankers state that it is too early to determine whether this mileage cannot be built by the pay-as-you-go plan.

Statements of the administration, as expressed by Frank T. Sheets, superintendent of highways, indicate that the state contemplates building 1,900 miles in 1923 and 1924, exhausting the available funds aside from current revenues and still leaving 1,200 miles of the 4,800-mile system uncompleted. Current revenue, he admits, will finish the system but on such a slow program that the final mileage will not be completed before 1929. Mr. Sheets does not believe Illinois is justified in waiting so long, nor that 4,800 miles is an adequate mileage. He therefore proposes a $100,000,000 bond issue for an accelerated and enlarged program, to be completed in the same time as the 4,800 mile system would be finished. This program would embrace a system

(*Continued on p. 806*)

Cabinet Defers Action on Girand Power Project

Immediate Action on License Application Denied—Arizona Protest Is Disregarded

Washington Correspondence

Discussion of the Girand project at Diamond Creek on the Colorado River at the cabinet meeting on April 20 resulted in a decision that no action be taken at this time on the application for license. This led the Federal Power Commission, at a meeting on April 23, to deny the plea of Mr. Girand for immediate action, as reported in these columns last week. It had been pointed out to the Cabinet officers composing the Federal Power Commission by the members of the commission's staff that all provisions in the Colorado River compact could be made conditions in any license issued for the Diamond Creek development. The action was taken with full knowledge that the Arizona legislature while in session had telegraphed the commission protesting vigorously against withholding action on the Girand application and stating that any such action on the part of the Federal Power Commission would be regarded as intolerable conduct in that it constitutes an effort of the federal government to coerce a sovereign state.

DISCUSSION OF POLICY

The Federal Power Commission first took up the discussion of its Colorado River policy at a meeting April 19. At that meeting, L. Ward Bannister, an attorney representing the Governor of Colorado, told the commission that Colorado is radically opposed to the granting of the Girand license until the Colorado River compact has been ratified. He said his state's experience in the cases of Kansas vs. Colorado and Wyoming vs. Colorado had been so unfortunate that Colorado is not willing to risk any further interstate litigation if it can be avoided. He declared that the doctrine of an equitable division of water on which the compact was based is much sounder than the doctrine of prior appropriation of water and nothing should be allowed to interfere with the prompt application of the doctrine set up in the compact.

Senator Kendrick, of Wyoming, told the commission that the entire history of irrigation in the West had been one of litigation. More money, he dclared, has been spent in lawyers' fees than in project works. So as to prevent any repetition of irrigation litigation, in the development of the Colorado River, he urged that no chance be taken in granting the Girand license. Senator Cameron, of Arizona, strangely enough, also opposed the Girand project on the ground that Arizona would be more greatly benefited by the Stetson project, which provides for a 1,200-ft. dam at Boulder Canyon, which would flood out the proposed Diamond Creek dam.

In the face of the very determined opposition voiced at the April 19 meeting, and in deference to his fellow-member of the commission, Secretary Work, who strongly sympathized with Colorado's contention, Secretary Weeks, the chairman of the commission, was willing to forego his own judgment that the Girand license should be granted and suggested that the policy be threshed out at the Cabinet meeting on the following day. Members of the power commission's staff made it very clear that in their opinion the only valid argument against granting the Girand license is that the delay holds a club over Arizona. They do not share the optimistic opinion expressed in some quarters that a special session of the Arizona legislature will be called and the compact ratified promptly.

The determination of the commission not to act on the Girand license applies with equal force to other Colorado River projects. Despite the very urgent plea made by Utah interests, and by the state itself, the commission has declined to take action on the preliminary permit asked by the Utah Power and Light Co., covering its Flaming Gorge project. The permit is essential to the work of exploring foundations and to the preparation of plans. The demand for power in Utah is growing at such a rate that a delay in the development of Flaming Gorge may make necessary the erection of steam plants at Salt Lake City, an alternative which is strongly opposed both on account of the higher rates which consumers would have to pay, and because of the aggravation of the smoke problem which would follow the erection of a large power plant.

Apparently, too, the Flathead Lake power project is enmeshed in delay and uncertainty comparable with the Colorado River situation. The staff of the Federal Power Commission urged at the April 23 meeting of the Commission that the Rocky Mountain Power Co. be given a preliminary permit, abundantly safeguarded to protect the interests of the State of Washington, so that it could do the preliminary work necessary to the 270,000-hp. development planned at the outlet of Flathead Lake. The commission decided, however, to withhold action until the special commission appointed by the Secretary of the Interior, to investigate the Columbia Basin plan, should report.

Zoning Restrictions Held Invalid

A decision rendered by the Fifth Court of Appeals of Dallas, Tex., on Apr. 13, held invalid a section of the city building ordinance which prohibits the erection of business buildings in residential districts. The case was brought before the court on appeal from the decision of a district court which granted a mandatory injunction compelling the city to issue a building permit which it had refused because of the restriction mentioned. The decision followed a prior Supreme Court decision in which it was affirmed that "it is not the law of the land that a man may be deprived of the lawful use of his property because his tastes are not in accord with those of his neighbors." The city is planning to appeal the case to the State Supreme Court.

N. Y. C. Would Extend Line

The Kanawha and West Virginia R.R. and the New York Central R.R. have applied to the Interstate Commerce Commission for authority to construct an extension of the line of the Kanawha and West Virginia R.R. from its present terminus at Swiss, eastwardly up the Gauley River, to the mouth of Meadow River, a distance of twenty miles, thence southwesterly up Meadow River to a connection with the Sewel Valley R.R. near Nallen, a distance of nine miles.

Newcomen Society Officer Is Guest at Loree Luncheon

L. F. Loree, president of the Delaware & Hudson Company, gave a luncheon in New York City April 20 in recognition of H. W. Dickinson, honorary secretary and treasurer of the Newcomen Society established in England two years ago for the study of the history of engineering and technology. Besides Mr. Dickinson, the luncheon guests included some twenty-five editors and publishers of technical papers and representatives of engineering societies. Among the after-lunch speakers were H. R. Towne, past president, Am. Soc. M. E., and president of the Yale & Towne Manufacturing Co.; W. L. Saunders, past president, A.I.M.E., and chairman of the executive board of the Ingersoll-Rand Co.; David Beecroft, editor, *Automotive Industries;* and Fred Low, editor, *Power.*

The object of the Newcomen Society is to collect and distribute among its members information regarding the history of engineering and technology and to act as a channel of communication between members who are engaged in this kind of historical research; to collect and preserve technical and biographical material, including illustrations relating to engineering work and industrial processes; and to form by collaboration among its members a card index of published information on the history of engineering and technology.

Membership in the society is open to all persons interested. The membership fee is £1 a year. Further details may be obtained from Mr. Dickinson, whose address is The Science Museum, London, S.W. 7, England.

Progress on American Falls River Project

The American Falls Reservoir district in Idaho on the Snake River will vote May 12 on a proposal for $2,700,000 bonds to finance the district's share in the construction of the dam. The storage required by the district will be 300,000 acre-ft. With the subscription of the district a reservoir of 900,000 acre-ft. is assured. An appropriation by Congress of $1,000,000 for expenditure by the U. S. Reclamation Service is available if expended before July 1. In consequence the district is making an effort to complete the election and confirmation of bonds in time to permit the $1,000,000 to be spent. This money will be used largely for right-of-way.

Los Angeles Union Depot Case in U. S. Supreme Court

The California Railroad Commission has filed a petition with the U. S. Supreme Court for a writ of review in the Los Angeles Union Terminal and grade crossing elimination case. The California Supreme Court ruled that the Railroad Commission had no jurisdiction to order the construction of a union terminal in Los Angeles for the three interstate railroads entering that city. The Commission contends that it has jurisdiction and is appealing to the United States Supreme Court to set aside the decision of the California Supreme Court. The case was noted in *Engineering News-Record* Dec. 22, 1921, p. 1039.

Antioch Water Case Revived in New Form

Another action to adjudicate the rights of the delta and upriver water users on the Sacramento and San Joaquin Rivers has been started by the filing of a suit by the Holland Land Co. and more than a hundred other plaintiffs against the Williams Irrigation District and some five hundred other users of Sacramento and San Joaquin river waters. The suit is similar to the Antioch suit noted in *Engineering News-Record* March 24, 1921, p. 513, and Oct. 5, 1922, p. 579 but in the new case the opposing interests are the rights of irrigators on the deltas and lower reaches of the river against irrigators farther upstream.

More than 400,000 acres are affected by the suit, all important tributaries of both the Sacramento and San Joaquin rivers are involved and the action specifically includes practically all important users of water in the upper river district.

This suit was instituted after it had become apparent that no success would attend the original Antioch case in which the plaintiff alleged that heavy diversions of water upstream caused salt water from the bay to pollute the Antioch municipal water supply. Antioch lost the fight in the State Supreme Court when that court reaffirmed a previous decision denying the city an injunction to restrain the Williams Irrigation District and other defendants from diverting water. A new move was then instituted by intervenors and delta land owners, in an application for permission to include 6,000 new defendants in the action, but this move lost when the Superior Court of Alameda County denied the motion.

Grade Separation Is Ordered at St. Louis

The Missouri State Public Service Commission on April 9 ordered the elimination of the grade crossing of the Wabash R.R. at Delmar Ave. in St. Louis. The separation will be made by track depression rather than by track elevation as proposed by the railroad. The cost, estimated to be $538,000, will be borne 40 per cent by the city and 60 per cent by the Wabash R.R. Co. This is the first step in a more comprehensive plan for doing away with five important grade crossings on the Wabash in St. Louis, and is the result of nearly twelve years of discussion.

Minnesota Road Program Held Up

Minnesota's highway program has received a setback due to the failure of the recently-adjourned legislature to provide for a $10,000,000 bond issue this year and for a like issue next year for trunk highway improvement. The highway department will now have only the proceeds of the motor vehicle tax for construction and maintenance. This year the sum expected is about $6,500,000. Of this only $1,000,000 will be usable for new construction, but an equal amount will be obtained from the federal government. Of this $2,000,000, three-fourths will be applied on contracts let last winter.

Defeat of the $20,000,000 bond proposal will necessitate a reduction in the highway department's force at its St. Paul headquarters and in the field.

Columbia Basin Project Field Work to Be Begun

Definite steps are to be taken during the coming week in the investigation of the Columbia River Basin reclamation project in Washington. Assistant Secretary of the Interior Goodwin, a member of the commission named by the Secretary of the Interior to conduct the investigation, will leave for Spokane, Wash., within the next few days where he will meet Director A. P. Davis, of the Reclamation Service, for the purpose of outlining plans for the field work. Four field investigators have been named to meet with the two commissioners in the field. Following this conference the field investigation will be started and will be continued until all necessary data have been compiled for the proposed irrigation of the Columbia River Basin. These field investigators are Homer J. Gault, engineer in charge of the Reclamation Service; Kirk Bryan, geologist of the Geological Survey; Glenn L. Parker, hydraulic engineer of the Geological Survey, and A. T. Strahorn, soil expert of the Department of Agriculture.

South Carolina Reorganizes Highway Engineering Force

The engineering forces of the South Carolina State Highway Department were generally reorganized at a meeting of the State Highway Commission here, the changes made by the highway engineer, Charles H. Moorefield, being confirmed by that body. The changes were made possible by the appropriation of more money by the general assembly for the department.

The new organization will be as follows: N. S. Anderson, chief of construction; Ambrose Harwell, chief of maintenance; W. C. Cathey, E. D. Sloan, J. M. Martin and W. K. Beckham, division engineers, having charge of the four districts into which the state is divided; Robert King, equipment engineer and J. C. Perrin, resident engineer.

Wilson Dam Construction Work Keeps Up with Estimate

Washington Correspondence

Work on the Wilson Dam at Muscle Shoals is 40 per cent complete. Progress is closely following the preliminary estimate. In March 34,586 cu.yd. of concrete were put in, of which 17,293 cu.yd. went into the dam, 17,000 into the power house, and the remainder into the lock.

Working conditions have been particularly favorable. There have been few days with rainfall enough to interfere with work, and no high water. Labor turnover has been small and the productivity of labor is much higher than two years ago. There has been no trouble in getting materials, since sand and aggregate are being secured locally by the regular working force and there has been no difficulty in maintaining an ample reserve of cement, the only material shipped in.

Wisconsin Societies to Co-operate

A recent conference of the presidents of the Engineering Society of Wisconsin, the Madison Technical Club, the Engineers Society of Milwaukee and the Milwaukee chapter of the American Association of Engineers resulted in recommending the organization of a joint committee consisting of one member from each of the the various engineering societies in the state, which committee will work on matters concerning the engineering profession in general. It has been recommended that the Wisconsin society appoint its representative, inform the other societies of its action, and take the initiative in calling together the various representatives. The president has appointed Jerry Donahue, Sheboygan, Wis., as this society's member of the joint committee. The Engineers Society of Milwaukee has also taken action and has appointed J. C. Pinney, dean of the college of engineering at Marquette University, Milwaukee, Wis.

Railroad Construction in the Bolivian Andes

CONSIDERABLE construction work is being done in South America by engineers and contracting organizations from the United States. Among New York firms engaged in South American work is the Ulen Contracting Corp. The view herewith shows a pile trestle being built in the Bolivian Andes on the Villazón-Atocha Ry. When completed this line will make rail travel possible from Buenos Aires to Peru. J. B. Cameron, of the Ulen company, who furnished the picture reproduced above, is chief engineer of construction on this line.

Court Upholds Federal Assessment on Arizona Project

The assessment of $75 an acre on land within the Yuma Irrigation Project, in Arizona, which was declared by the Secretary of the Interior in 1917, was clearly in accordance with the law and the contract, according to a decision rendered by the United States Supreme Court April 30, in the case of the Yuma County Water Users Association against officials of the Reclamation Service.

The project was started in 1904. Unofficial estimates placed the cost of a dam across the Colorado River and other works at a figure which would bring an assessment of approximately $35 an acre. Great difficulties were encountered in the construction works, and the contractor abandoned the contract, which was completed by the Federal government at a cost more than double the unofficial estimates. When the Secretary issued his order assessing $75 an acre, the landowners, through their association, brought suit, claiming that $35.28 an acre was the contract assessment. The lower courts, and the Supreme Court, held that the preliminary estimates of cost were unofficial and not part of a contract.

Illinois Opinion Divided on Good Roads Issue

(*Continued from p. 803*)

of 7,300 or 7,800 miles, harmonizing with the 7 per cent provision in the federal aid law. Due to the increased number of motor cars over the number estimated when the former issue was put through, there is sufficient revenue to pay interest and sinking funds to amortize both old and new issues. The new bonds, like the old ones, would be 20-year serials. All the arguments developed in the eight years' campaign for the $60,000,000 issue hold for the new issue, says Mr. Sheets. The new program will establish a definite business policy for the next few years and thereby greatly reduce the overhead. Should the legislature pass the bill the people must still vote on it, the earliest opportunity being the fall of 1924, thus not making the money available before the 1925 season.

With an additional $100,000,000 for roads the bonded indebtedness of the state is greatly increased. There are now in addition to the $60,000,000 road bond issue, a $20,000,000 obligation for water-way bonds and $55,000,000 for a soldiers' bonus. While the road bonds are paid from the automobile license fees, nevertheless it is the state's credit and taxing ability which are behind the bonds. Taxes have doubled in the last 5 or 6 years. The average voter is much more responsive to demands for economy in the conduct of government than he was a few years ago. He remembers all too vividly his doubled tax.

The plan in dispute is one to submit to these voters the decision whether a debt of $100,000,000 shall be assumed not merely to complete the planned system of 4,200 miles but to increase this system by an additional 2,000 to 3,000 miles. Leaving consideration of whether a larger system is needed until another time, it seems plain that the logical action is for the legislature to put the present question before the people, who possess the right to decide and not the bankers, administration or legislature.

San Francisco Bay Bridge Contract Is Let

The Webb San Francisco Bay Bridge Co., which holds the franchise for a six-mile bridge across the south end of San Francisco Bay from San Mateo, on April 27 awarded the contract for building the bridge to the Coast Construction Co. for $10,000,000. This includes seven miles of approach roadway. The company has filed a $1,000,000 bond to guarantee faithful performance of the work which is to start immediately and is to be completed in three years. For a distance of one mile the water is 40 ft. deep and this will be bridged by a 200-ft. lift span and arches of 250-ft. span. Shorter concrete arches will be used for two half mile approaches and the remaining four miles will consist of trestle or fill. The roadway is to be 60 ft. wide.

Prof. Whipple to Retire from the Massachusetts Health Council

George C. Whipple, professor of sanitary engineering at Harvard University, has informed the Governor of Massachusetts that on the expiration of his present term of membership, May 1, on the Massachusetts Public Health Council of the State Department of Health he wishes to retire from the service. This action has been taken in order that Prof. Whipple may have more opportunity to devote to professional work on one hand and to teaching on the other.

Prof. Whipple informs *Engineering News-Record* that he has considered it inappropriate to accept any professional engagement in Massachusetts during the nine years he has been a member of the Public Health Council. Hereafter he expects to do more private work, but in so far as possible, he states, this will be done in association with other engineers rather than in competition with them, as it seems to Prof. Whipple that "this should be the true attitude of a college professor toward his engineering colleagues."

Boulevard Slide in Pittsburgh to Be Taken Into Court

Announcement by the Pennsylvania R.R. last week stated that the company will bring suit against Pittsburgh for damage and expenses caused by the Jones Hollow slide along Bigelow Boulevard two years ago. As reported in *Engineering News-Record* Nov. 25, 1920, p. 1058, the railroad temporarily lost the use of half a dozen or more tracks and was put to large expense in the emergency work necessary to keep pace with the progress of the slide and ultimately remove the material that flowed out on the tracks. After the slide was stopped, the railroad company filed a claim with the city for about $1,000,000 damages, but the city authorities tabled the claim. Subsequent conferences on the claim came to nothing, and it is now planned to settle the question of liability in the courts. The city regarded the slide as an Act of God, and considered itself absolved from liability by this fact.

Testing Materials Society Announces Program

The program for the annual meeting of the American Society for Testing Materials has just been announced. It will last from Monday, June 25, through Friday, June 29. The morning and afternoon of Monday will be devoted to committee meetings, and the first session Monday evening is on non-ferrous metals and alloys. On Tuesday there will be three sessions; in the morning, on corrosion, fatigue of metals and magnetic analysis; in the afternoon, on wrought and cast iron, coal and coke, and heat treatment, the early part of the evening being devoted to the presidential address and the latter part to an informal dance and smoker.

On Wednesday, the morning session is on steel and methods of testing and the evening session on a symposium of consistency and testing of glue. There will be no afternoon meeting. On Thursday, the morning meeting is on road materials, waterproofing and thermometers; the afternoon meeting on timber, rubber and textiles, and in the evening there will be simultaneous sessions—one on preservative coatings and the other on cement, lime, gypsum and ceramics, and nomenclature. On Friday there will be two morning sessions—one on petroleum products, electrical insulating materials, and slate, and the other on concrete. The afternoon will be devoted to a golf and tennis tournament, and the evening a final meeting at which there will be discussed a symposium: What properties of and methods of making concrete require further investigation?

Important papers to be presented include "Endurance Properties of Steel: Their Relation to Other Physical Properties and to Chemical Composition," by D. J. McAdam, Jr.; "A New Method of Magnetic Inspection," by A. V. de Forest; a topical discussion "Is It Desirable to Include Chemical Requirements in Cast-Iron Specifications?"; and studies on the use of calcium chloride in concrete.

The nominating committee has announced the regular nominations for officers as follows: President, Guilliaem Aertsen, Midvale Steel & Ordnance Co., Chicago; vice-president, W. H. Fulweiler, chief chemist, United Gas Improvement Co., Philadelphia; for members of the executive committee, J. B. Chubb, Universal Portland Cement Co., Chicago; T. G. Delbridge, Atlantic Refining Co., Philadelphia; H. L. Scott, Henry L. Scott & Co., Providence, R. I.; P. H. Walker, U. S. Bureau of Standards, Washington, D. C.

Contractor Liable for Extra Cost on Galveston Causeway

The decision of the District Court and of the Court of Appeals that the Galveston Causeway Construction Co. (formerly Larkin & Sangster, Inc.) and its surety, the United States Fidelity & Guaranty Co., must pay the Galveston, Harrisburg & San Antonio Ry. Co. and other railroads $652,626 for excess cost of the causeway connecting Galveston Island with the mainland of Texas will stand, the U. S. Supreme Court having denied a petition for a writ of certiorari April 30.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

The Société des Ingenieurs Civils de France, Section Americaine, will hold a joint meeting with the four founder societies on May 4 at the Engineering Societies Building, New York City. The occasion is the 75th anniversary of the founding of the French society.

The Utah Society of Engineers, at its regular meeting, April 18, had as its principal speaker Brig. Gen. U. G. McAlexander, U. S. Army, who spoke on the engineering features of the second battle of the Marne. Brig. Gen. McAlexander, at the opening of the war a colonel, commanded the 38th Infantry which held a pivot position at Chateau-Thierry.

The Colorado Society of Engineers at its recent discussion of municipal affairs had as its principal speaker Professor E. H. Gardner, marketing and advertising expert of the University of Wisconsin.

Personal Notes

E. P. LAMB, formerly with the Jahncke Dry Dock Co., of New Orleans, La., has been appointed district manager of the Trans-Continental Engineering Company's New Orleans office.

CHARLES A. PATTERSON, formerly town and city engineer of Torrington, Conn., has recently opened an office in the Chamber of Commerce Building, that city, to engage in the practice of engineering and architecture.

JOHN M. BELKNAP, for the past seven years connected with the engineering department of the Lord Construction Co., New York City, has resigned to accept a position as resident engineer for the Terry & Tench Co. on the construction of the Bear Mountain-Hudson River bridge and highway approaches at Peekskill, N. Y.

ARTHUR J. BENLINE has reopened consulting offices at 1910 Webster Ave., New York City, where he will again practice architectural and structural engineering.

WALTER CLEMENS GERNT, formerly with the H. J. Clemens Co., of Detroit, Michigan, has become associated with J. French Paddock and associates, Detroit, civil, architectural and landscape engineers. Mr. Gernt will act as general manager and will specialize in design and installation of waterworks, and hydraulic equipment.

CARL G. YARLING has been appointed assistant engineer of Kokomo, Ind., under Charles L. Sellers, as city civil engineer, appointment to become effective May 1. FRED DAVENPORT, who was employed by the city as special engineer for the construction of the large Washington street sewer in 1921, was appointed surpervising engineer to assist Mr. Yarling in carrying through the heavy street building program already begun this year.

COL. WILLIAM B. GREELEY, chief forester, U. S. Forest Service, has been awarded a Distinguished Service Medal by the War Department. Col. Greeley supervised the operations of all forestry troops in France and was awarded the Legion of Honor by the French Government and the Distinguished Service Order by Great Britain.

M. C. NOBLE, recently appointed, chief, bureau of roads and bridges, Nebraska Department of Public Works, has been in road work in the Middle West for a number of years. He was graduated from Iowa State College, from which institution he secured a civil engineering degree, and after graduation spent a year on land drainage in Minnesota and Iowa. During the next three years he engaged in road, bridge, drainage and land surveying work in Iowa. During the war he was a first lieutenant in the Coast Artillery Corps, spending fourteen months overseas. Upon his return he was made project engineer with the Nebraska Department of Public Works and later became assistant division engineer. Previous to his appointment as chief of the bureau of roads and bridges he was division engineer with the Nebraska Department of Public Works.

PAUL E. GREEN, consulting engineer, Chicago, has been appointed by the finance committee of the Chicago City Council to investigate and report on all street pavements laid in 1922. An appropriation of $40,000 is available for the work.

COLONEL CHARLES KELLER, whose resignation as Engineer Commissioner of the District of Columbia was noted in these columns recently, has become associated with the Byllesby Engineering & Management Corp. He is now on the ground as business manager of the El Dorado hydro-electric project, under construction by the Western States Gas & Electric Co. in the Sierras near Placerville, Calif.

H. A. VAN NORMAN, assistant engineer in the bureau of water-works and supply of the Los Angeles, Calif., board of public works, has been appointed special consulting engineer to advise the board on sewer construction work under a recently voted bond issue of $12,000,000. Mr. Van Norman was division engineer on the construction of the Los Angeles aqueduct and later was in charge of the Owens Valley and part of the Mojave divisions where the large steel siphons were constructed.

C. N. PHILLIPS, formerly office engineer for the Miami Conservancy District, Dayton, Ohio, has accepted a position with the Electric Bond and Share Co. of New York. Mr. Phillips was associated with the flood-prevention work for six and one-half years as field engineer in charge of preliminary surveys, and, during the construction period, as office engineer, acting as personal assistant to the chief engineer, Arthur E. Morgan, and Charles H. Paul, his successor.

Obituary

JOHN G. RODGERS, vice-president of the Pennsylvania R.R., in charge of the northwestern region and located at Chicago, died April 11 at Camden, S. C. He was born in Philadelphia, Pa., in 1865. In 1882 he entered the service of the Pennsylvania R.R. as rodman and became an assistant engineer, but later went into the operating department.

HENRY A. YOUNG, of the consulting engineering firm of Young & Hyde, Inc., New York City, died at his home in Maplewood, N. J., April 23. Mr. Young had been engaged in the design and construction of fortifications in the United States Engineering Department, and later as engineer in the United States Reclamation Service. He was identified with the construction of the Huntley Irrigation Unit, at Huntley, Montana. In 1906 he took charge of the design and construction of a water supply system for the City of Camaguey, Cuba, and shortly after his return to New York in 1909 formed the firm of Young & Hyde, Inc.

MAX GARY, the well-known German cement expert and professor, died in Berlin on April 9 in his sixty-fourth year. Prof. Gary was connected with the government testing laboratory at Dahlem, Berlin, for many years. His investigations into cement are among the best known of the German studies. He was in this country in 1912 attending the last meeting of the International Association for Testing Materials.

Dr. S. S. WHEELER, one of the founders of the United Engineering Society and former president of the American Institute of Electrical Engineers, died at his home in New York, April 20, aged 64 years. Dr. Wheeler, educated at Columbia College, New York City, was given an honorary degree of Doctor of Science by Hobart College and Master of Science by Columbia University. He was one of the early associates of Thomas A. Edison, being the designer and manufacturer of one of the first successful small motors made. At the time of his death he was at the head of the Crocker-Wheeler Co., Ampere, N. J., large manufacturers of electrical machinery.

W. J. MURPHY, builder of the Arizona canal, which irrigates half of the acreage of the Salt River valley, and for years connected with railroad construction in the southwest, died at Phoenix, Ariz., April 17, at the age of 84. He was born in New Hartford, N. Y.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Asphalt Producers Confer on Fewer Varieties

Meeting at Department of Commerce Lays Foundation for Waste Elimination Program

IN LINE with Secretary of Commerce Hoover's program for the elimination of waste in industry producers of asphalt for paving work, representing a large percentage of the country's yearly output, met in a preliminary conference with the Division of Simplified Practice of the Department of Commerce in Washington April 24, endorsed the general principle of reducing excess varieties of their product, fixed May 28 as the date of a general conference of producers and users of asphalt, the latter to be represented by delegates from the principle engineering societies and specification-making bodies in the road and paving field, and recommended as a basis for discussion at the forthcoming meeting the penetration limits for asphalt embodied in the tentative specifications of the American Society for Testing Materials. The producers also agreed unanimously to submit to the Department of Commerce before the next meeting figures, in percentages of shipments during 1922, indicating the range of varieties of asphalt for road work they were called upon to produce. Last week's meeting, arranged between the Asphalt Association of New York and the Department of Commerce, followed a presentation of the case for fewer grades of asphalt and a subsequent discussion both by users and producers published recently in *Engineering News-Record*.

Needless Waste in Present Practice

The preliminary conference was attended by representatives of the leading producing companies and was opened by William A. Durgin, chief of the Commerce Department's Division of Simplified Practice, who explained the general features of Mr. Hoover's program of waste elimination in industry. R. M. Hudson, Mr. Durgin's assistant, presided at the session. J. R. Draney, U. S. Asphalt Refining Co., New York, outlined the history of attempts at reducing the number of grades of asphalt called for in road and paving specifications, emphasizing the point that in different sections of the country different penetration limits were demanded for material under identical conditions of traffic and temperature. Present practice, he stated, results in a needless waste of labor at the refineries, requires excessive storage and increases capital costs.

Supplementing Mr. Draney's remarks, Prevost Hubbard of the Asphalt Association referred to the work on simplification of grades done by the U. S. Bureau of Public Roads, the Asphalt Association, and the American Society for Testing Materials. The latter organization now has tentative specifications which confine the grades, as determined by penetration, to eight. About one-half of the country's asphalt tonnage, Mr. Hubbard pointed out, goes into paving work and the remainder into roofing and manufactured products.

Col. Compton Presents Data

As a basis for discussion, Col. R. Keith Compton, chairman, Paving Commission, Baltimore, presented the results of a questionnaire sent out in November and December, 1922, to cities and state highway departments asking for a statement of penetration limits specified for various types of asphalt pavement, including asphalt macadam, asphaltic concrete (coarse aggregate), asphaltic concrete (fine aggregate), and sheet asphalt. For asphalt macadam 33 different sets of penetration limits were reported; for asphaltic concrete (coarse aggregate), 25; for asphaltic concrete (fine aggregate) 27; and for sheet asphalt, 49. Col. Compton's figures were regarded as convincing evidence of an opportunity for simplification.

What the present demand for varieties means in the way of added expense at the refineries was explained by Herbert Spencer, of the Standard Oil Co. of New Jersey, who referred to such items as additional pumps and pipe lines, storage facilities, land and general overhead expense. The state highway departments, it was pointed out, call for a greater variety of asphalt grades than do other consumers.

Speaking for the Texas Co., William H. Kershaw told how his organization had met demands for large tonnages during 1922 with 5 standard consistencies based on a penetration scale of 40-50; 50-60; 60-70; 90-100; 115-130. In addition, another grade for paving block filler was produced. Mr. Kershaw endorsed the 8 ranges of penetration embodied in the tentative specifications of the American Society for Testing Materials.

C. N. Forrest, of the Barber Asphalt Co., Maurer, N. J., stated that the limit of accuracy of the penetration test is 4 to 5 points, so that specified ranges involving differences of one or two points are a needless refinement. R. S. Townsend, of the Atlantic Refining Co., Philadelphia, believed that six or seven asphalt grades for paving and road work, with an additional grade for block filler, would meet all reasonable requirements. L. M. Law, of the New Orleans Refining Co., told that during 1922 his organization had been able to fill 52 per cent of its orders with 5 grades of material; the remaining 48 per cent had required 20 different penetration ranges.

Engineers at Second Conference

On motion by Mr. Kershaw, it was decided to limit the scope of the proposed program for eliminating varieties to asphalt for paving, excluding road oils and surfacing materials and asphalt used for roofing. A motion also was passed putting the industry, as represented at the meeting, on record as desiring to reduce varieties of asphalt used for paving purposes.

After further discussion the meeting unanimously adopted a resolution recommending as the basis for discussion at the May 28 meeting the scale of 8 penetration limits for paving asphalt included in the tentative specifications of the American Society for Testing Materials. The penetration scale referred to is as follows: 25-30; 30-40; 40-50; 50-60; 60-70; 70-90; 90-120; 120-150; or a total of eight grades. (The first two limits have been recommended by Committee D-4 but not yet adopted as tentative.)

At the forthcoming meeting on May 28, the following organizations, in addition to the producing companies, will be invited to send representatives: American Society for Testing Materials; American Society of Municipal Improvements; American Association of State Highway Officials; American Society of Civil Engineers. In addition, it is planned to have representation from the U. S. Bureau of Public Roads, the United States Chamber of Commerce, and the engineering press.

Those who attended the April 24 meeting were: William A. Durgin and R. M. Hudson, Division of Simplified Practice, Department of Commerce; Herbert Spencer, Standard Oil Co. of New Jersey; J. R. Draney, U. S. Asphalt Refining Co.; C. N. Forrest, Barber Asphalt Co.; Prevost Hubbard and J. E. Pennybacker, the Asphalt Association; Irvin K. Giles and R. S. Townsend, Atlantic Refining Co.; Benton L. Boye, Standard Oil Co. of New York; W. H. Kershaw, the Texas Co.; L. M. Law, New Orleans Refining Co.; E. W. McCullough, U. S. Chamber of Commerce; Col. R. Keith Compton, Baltimore Paving Commission; and R. K. Tomlin, Jr., associate editor, *Engineering News-Record*.

To Sell Universal Cement by Bag Instead of Barrel

Beginning June 1, Universal portland cement will be sold and invoiced by the sack instead of by the barrel. This change, the company announces, is made only after sending an inquiry to thousands of cement buyers, including dealers, contractors, architects and engineers, large industrial concerns and others. The replies were overwhelmingly in favor of the change.

To Simplify Sewer Pipe

Washington Correspondence

A survey of types and varieties of sewer pipe, drain tile and specials, flue linings and specials and wall copings and specials looking toward elimination of excess types is to be undertaken by the Eastern Clay Products Association and the Clay Products Association. A meeting of all interests concerned will be held Oct. 22 to consider the results of the surveys. This is the result of a preliminary conference on the subject held April 23 with the Division of Simplified Practice of the Department of Commerce.

The conference decided to have the two associations make a survey of the field in the materials mentioned, using the data each now has and filling in as is required, and to submit the results to a final conference Oct. 22.

Argue Trade Data Exchange Case Before Supreme Court

Issues of Price Agreements and Trade Association Activities Involved in Government Appeal

Washington Correspondence

Arguments were presented April 25 and 26 before the United States Supreme Court in the case of the government against the American Linseed Oil Co. and others, involving the right of business to exchange trade information through associations or through private bureaus acting as clearing houses for such data. The case is considered to be the most important to trade associations since the hardwood lumber case, but it involves different questions than the latter.

The Federal government alleged that by exchanging various forms of information which were distributed as statistics by the Armstrong Bureau of Related Industries the defendant linseed oil companies created a condition tending to prevent competition in prices of their product. The United States District Court for Northern Illinois, where the suit originally was instituted in 1921, held for the defendants and ordered the suit dismissed, the government appealing.

In arguing before the Supreme Court, Special Assistant Attorney General James A. Fowler declared that daily and instantaneous price reports were sent the bureau by the linseed oil members, and relayed back to the members by the bureau, and charged that each day each member knew the prices quoted by his competitors.

Lakewood Wins Appeal on Carr Finishing Machine Patents

In an opinion just rendered by Judge Page, the U. S. Circuit Court of Appeals for the Seventh Circuit has upheld the validity of the Carr strike-off and tamper patents for concrete-road finishing machines, manufactured by the Lakewood Engineering Co., Cleveland, and has declared the Maxon finishing machine an infringement. The decision just rendered reverses the ruling of the lower court which dismissed the Lakewood Company's claims. The principals in the case were Edward G. Carr and the Lakewood Engineering Co., against Glenway Maxon, Jr. The opinion of the Court of Appeals concludes with this statement: "The claims of both Carr patents are valid and infringed, and the decree is reversed with the direction to enter a decree for an injunction and accounting."

In discussing the rival claims the Court said: "In 1920, appellee, [Maxon] a former employee of Carr, made the machine complained of and put it into use. Appellee's description of his machine shows clearly that there is no substantial difference between it and appellants' [Lakewood's] machine. The chief claim of difference is that, whereas appellants' tamper has a quick up-and-down motion, the tamper in appellee's machine drops until it comes in contact with the road, and, as the piston comes up in the cylinder, the pressure is built up and forces down the tamper until it reaches the limit of its strike, which is the top of the forms. By this alleged operation, it is urged that appellee escapes infringement of the vibratory element in appellants' claims. . . . As the whole movement [of the Maxon tamper] is made by the regular uninterrupted motion of the engine, transmitted through its crank-shaft and the piston attached thereto, the movement of the tamper must have the same regularity and cannot go down slowly and come up quickly as claimed. There is no difference between the operation of the tampers in the two machines, and we are of opinion that infringement is clearly shown."

Space for Water-Works Exhibit at Detroit Over-Subscribed

Water-works manufacturers have over-subscribed the space available for exhibits in connection with the annual convention, in Detroit, of the American Water Works Association, May 21-25. In order to take care of all applications the exhibit committee, of which George McKay, Jr., is chairman, has been compelled to reduce the amount of space desired by exhibitors wanting more than two booths.

Business Notes

SERVICE MOTORS, INC., a Delaware corporation, has taken over the business of the Service Motor Truck Co., Wabash, Ind., and will continue to build motor trucks and railroad motor coaches. This is a result of the reorganization plans started last November and is said to assure adequate capital to meet all needs for manufacturing and further expansion. Paul Moore is president and general manager of the organization.

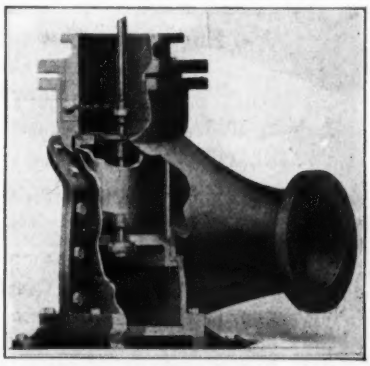
BUCYRUS CO., South Milwaukee, Wis., announces the appointment of W. M. Myers as works manager, effective last month. Mr. Myers is a native of Richmond, Va., and has served with the American Locomotive Co., the Baldwin Locomotive Works and the Lima Locomotive Works. He resigned from the last named company to accept a commission as officer in the Ordnance Department of the Army in 1917. At the close of the war he was commissioned in the Ordnance Department of the regular Army and was stationed at the Watertown Arsenal.

FLOYD C. FURLOW, president, the Otis Elevator Co., died April 26 in New York. He was 46 years old and had been connected with the Otis company for 18 years; he was made president five years ago. He was educated at Georgia Institute of Technology and at Worcester Polytechnic Institute. For several years he pursued the profession of consulting engineer at Atlanta and at the same time was a lecturer in experimental engineering at Georgia Tech. In 1902 he was made chief engineer of the Plunger Elevator Co. of Worcester, Mass., and two years later became vice-president of that company. Mr. Furlow became chief engineer for the Otis Elevator Co. in 1905 and soon after was made vice-president and then president.

Equipment and Materials

Valve for Water Columns

Absence of cup packing, direct flow of water and reduced number of parts are the main advantages of a new valve for railway water columns which has been introduced by the T. W. Snow Construction Co., Chicago. With the valve in closed position, as shown, the bottom chamber is filled with water which leaks in around the lower part of the plunger or main valve. The first downward movement of the valve rod opens the pilot valve in the bottom of the main valve thus allowing the water to escape upward but to act



as a cushion as the main valve descends into the chamber. In this open position there is almost unobstructed flow from the main to the water column, as the water does not flow through or around the valve and there are no ports or by-passes to clog or freeze up. The long sweep of the curved connection is also claimed to reduce materially the friction of the water. As the valve is raised, its bottom flange tends to pocket water above it, the only escape being the tapered clearance space. In this way the valve forms its own dashpot to prevent sudden closing and consequent water hammer. A large bolted door on the water chamber enables the entire valve to be removed after disconnecting one attachment to the valve rod. The vertical pipe of the water column is seated on a ball bearing.

Welded-Flange Pipe Coupling

To prevent corrosion at exposed threads of pipe having screw flanges or couplings the National Boiler Washing Co., Chicago, has developed a joint formed by drop-forged steel flanges welded to the pipe, thus eliminating threads. In installing a boiler-washing plant for a railway roundhouse the piping is located on the plans, lengths and angles being determined accurately. Pipe is cut to length at the shop and then fitted with the drop-forged flanges, which are bored to the proper angle, heated, shrunk in place and finally welded. The faces of the flanges are ground at the proper angle to give a smooth surface for the gaskets. It is stated that with the piping thus completed at the shop there is material reduction in the time and cost of installation as compared with work where the piping is cut, bent and threaded in the field.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Average Weekly Value of April Contracts Let Over 59 Per Cent Heavier Than in 1922

Total of 794 Awards During April, Average Value $250,629 Compared With 912 in March, Averaging $263,000

Contracts awarded in the four issues of *Engineering News-Record* during April, totaled $198,665,000 as compared with $240,349,000 in the five issues of March. This represents an average weekly value of $49,750,000 for April, against $48,000,000 during the preceding month.

The number of awards totaled 794 during April, with an average value of $250,629 as compared with 912 in March, averaging $263,000 per contract.

The April weekly average, $49,750,000, represents an increase in money value of 14 per cent above the weekly average of $43,313,000, for the corresponding period in 1920. Weekly average for April, 1921 was $26,417,000.

Minimum costs observed in Constructions News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Engineering News-Record Construction Cost Index Number

May, 1923	216.70
April, 1923	213.50
May, 1922	164.62
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 3.2 points since last month, due to higher lumber and steel prices and stiffening in labor rates. Yellow pine rose $2 per M. ft. in month. Steel contract prices higher; demanding of premiums for quick deliveries, less frequent. The average rate for common labor is now 51c. Thus, general construction cost is 31 per cent higher than one year ago and 20 per cent under the peak; it is 116 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly		
April, 1923	(*4 issues of E. N.-R.*)	160
March, 1923	(*5 issues of E. N.-R.*)	195
April, 1922	(*4 issues of E. N.-R.*)	150
1913		100
Yearly		
1922	(entire year)	130
1921	(entire year)	88
1920	(entire year)	91
1913		100

Engineering News-Record's Construction Volume Index Number is 160 for the month of April, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 160 for April, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING APRIL, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Water-works	$152,000	$5,063,000	$1,207,000	$987,000	$934,000	$151,000	$50,000	$8,544,000
Sewers	116,000	1,672,000	251,000	2,830,000	370,000	258,000	.....	5,497,000
Bridges	25,000	503,000	420,000	714,000	1,163,000	104,000	381,000	3,310,000
Excavation, drainage and irrigation	.....	50,000	29,000	1,101,000	1,135,000	72,000	119,000	2,506,000
Streets and roads	451,000	4,200,000	5,548,000	6,734,000	7,712,000	2,315,000	2,681,000	29,641,000
Industrial works	4,562,000	13,490,000	673,000	7,367,000	11,605,000	5,334,000	2,750,000	45,781,000
Buildings	6,650,000	27,263,000	9,094,000	15,177,000	12,195,000	7,371,000	1,649,000	79,399,000
Federal government	46,000	1,051,000	439,000	2,276,000	314,000	1,152,000	.....	5,278,000
Miscellaneous	1,625,000	4,857,000	275,000	2,755,000	957,000	3,978,000	4,262,000	18,709,000
Total	$13,627,000	$58,149,000	$17,936,000	$39,941,000	$36,385,000	$20,735,000	$11,892,000	$198,665,000

Cement Consumption Increases

Portland cement consumption in the Eastern states of the country between 1918 and 1922 increased 64 per cent, or from 22,963,000 to 37,688,000 bbl., according to a study just made by the Cement Information Service. The greatest increase in the use of portland cement during this period occurred in the State of New York, where shipments grew from 6,335,000 bbl. in 1918 to 13,212,000 bbl. in 1922, or an increase of 109 per cent.

The largest per capita consumption of cement throughout the Eastern states in 1922 occurred in Delaware where 1.60 bbl. per person were used; in New York the consumption per capita in 1922 was 1.23 bbl.; in New Jersey 1.50 bbl., and in Pennsylvania 1.15 bbl. Over 11 per cent of all the Portland cement consumed in the country in 1922 was used in New York State.

There were 13,055,000 bbl. of cement available at mills throughout the entire country, Apr. 1, 1923.

Building Interests Plan Check on Rising Costs

New York Contractors, Architects, Bankers and Others Appoint Committee of Fifteen to Act

TO DEVELOP a plan for relieving the acute situation in New York building construction caused by rapidly rising costs of labor and materials, a conference was held April 30 at the Engineering Societies' Building, at which were present more than 100 contractors, architects, bankers, real estate men, merchants and representatives of insurance companies. After a general discussion an advisory committee of fifteen was appointed to seek a remedy for conditions which threaten to halt the present construction program in the metropolitan district. With bricklayers demanding $12 to $14 a day and common labor on construction work from $7 to $8 a day, according to testimony brought out at the meeting, wages are undergoing what was characterized as a "snow-balling" process, constantly rolling up into larger sums. Cass Gilbert, architect, said that he had advised clients against building projects amounting in the aggregate to $5,000,000. A policy of discouraging new building ventures under present condi-

tions was also announced by R. H. Shreve of the firm of Carrere & Hastings, architects.

Instances of ever increasing demands on the part of labor were cited by representatives of the Fred T. Ley Co., the Thompson-Starrett Co., and George A. Fuller Co., Marc Eidlitz & Sons, and the Barney-Ahlers Co. W. J. Barney, head of the organization just named, brought out the further point that labor was only one of the present difficulties. Material prices have undergone great increases, he said, and it is difficult and often impossible to secure deliveries without payment of premiums. Many contractors, he predicted, may be forced to shut down work rather than assume the ever-mounting costs.

The need for drawing up immediately a program of action was stressed by many of the speakers. This will be one of the duties of the committee of fifteen above referred to, including in its membership three representatives from each of the following interests: Builders, architects, bankers, owners, and general industry. As representatives of the construction interests the following were named members of the committee: Otto M. Eidlitz, of Marc Eidlitz & Sons; W. S.. Faddis, of Caldwell Wingate Co.; and Louis J. .Horowitz, president, Thompson-Starrett Co. This week's meeting, it is understood, is the outcome of the recent letter from Secretary Hoover, reprinted elsewhere on this page, suggesting that the federal government would gladly co-operate in relieving the building situation provided the construction industry took preliminary action by drawing up some sort of definite program on which to act.

Railway Statistics Issued

In its annual bulletin, recently issued, the Car Service Division of the American Railway Association presents a statistical digest of related economic and transportation factors applied to the movement of the country's production during the year 1922. Cars of revenue freight loaded totalled 43,713,519, as compared with 39,323,158 in 1921; 45,118,472 in 1920; and 41,836,910 in 1919. The total car loadings (23,465,127) for the second six months of 1922, the period including the shopmen's strike and the two coal strikes, were only 0.8 per cent less than for the corresponding six months of 1920, which was the record loading in the history of American railway operation.

CARS AND LOMOTIVES AWAITING REPAIRS

1922	Cars	Locomotives
July 1	324,583	14,412
July 15	342,079	15,764
August 1	345,013	18,078
August 15	335,575	18,963
September 1	321,674	19,841
September 15	304,548	20,157
October 1	291,654	19,727
October 15	270,045	19,231
November 1	249,960	18,366
November 15	235,660	18,356
December 1	226,288	18,009
December 15	213,837	17,883
1923		
January 1	216,011	15,549
January 15	217,200	16,073
February 1	209,471	15,412
February 15	206,585	15,581

The railroads are making progress in restoring the condition of equipment impaired during the shopmen's strike. The figures above from July 1, 1922, to Feb. 15, 1923, show the number of cars and locomotives awaiting repairs.

Cement Production Reaches Record Figures

Production and shipments of portland cement for March and for the first quarter of this year are greater than for any similar period in the history of the industry.

In order to meet the demand, the industry is now producing at an unprecedented rate. The production of 9,880,000 bbl. in March shows a gain of 47 per cent over that month in 1922, while production during the first three months amounted to 25,669,000 bbl., or a gain of 68 per cent over last year.

Stocks of finished portland cement in the warehouses of the various producers amounted to 13,055,000 bbl. at the end of March. With a yearly capacity of all producers ranging between 140,000,000 and 150.000,000 bbl., there will be no cement shortage this year, according to the Atlas Co., provided there is no railroad embargo and that purchasers do not concentrate their orders during the peak months.

Western Pine Manufacturers Sued

By direction of Attorney General Daugherty a suit in equity against the Western Pine Manufacturers' Association, comprising approximately 50 corporations, and 86 individuals, officers of the companies and others, was filed April 30 by Lafayette French, Jr., U. S. Attorney for the district of Minnesota, in the U. S. District Court, at St. Paul, praying that an injunction issue against the association and the individuals named, as constituting "a combination and conspiracy in restraint of interstate trade and commerce in lumber."

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market quiet; all business remains at $27 base, Birmingham, as of month ago. Eastern Pa. No. 2X, dropped $1.12 per ton in month. Basic iron rose 50c. in Philadelphia and $1 in Cincinnati; No. 2 foundry, $1 in Pittsburgh and Chicago and gray forge, 50c. per ton in Philadelphia, since last month.

Railway Supplies—Rail buying continues fairly active, particularly in West. Minimum on light rails now $45, against $43 last month, at Pittsburgh mills. Standard rails remain at $43 per ton f.o.b. mill. Track supplies and red oak ties higher in St. Louis; spikes, bolts a d angle bars also advanced at Birmingham.

Pipe—Black and galvanized wrought-steel pipe discounts dropped two points on Pittsburgh basing card of Apr. 19, change reflected in New York warehouse discounts. Birmingham mill base now $49 on 6-in., class "B," cast-iron pipe, against $48 per ton, one month ago. Rise reflected in New York, Chicago and St. Louis warehouses. Sewer pipe and clay drain tile cheaper in St. Louis; slight advances in sewer pipe in Baltimore and Boston.

Road Oils and Asphalt—Advance of ¼c. per gal. in road oils, f.o.b. New York; slight declines in St. Louis. Scarcity of Mexican oil has manifested itself during last thirty days. Asphalt advanced in Boston, St. Louis, Baltimore, Montreal and Philadelphia.

Paving Materials—Granite blocks down 50c. per M. in Philadelphia; advanced slightly in Kansas City and Boston. Wood blocks up 15c. in Boston and 35c. per sq.yd. in New Orleans due to upward tendency in price of oil. Crosswalks, 6 x 24-in., and 5 x 16-in. bluestone curbing higher in New York.

Sand, Gravel and Crushed Stone—Sand, $1.25 in New York, against $1 per cu.yd. one month ago. Advances also reported in St. Louis, Dallas, Boston, Los Angeles, Baltimore and Birmingham, due mostly to higher labor costs. Sand down slightly in New Orleans. Gravel higher in St. Louis and Boston. Crushed stone up in St. Louis, Boston, Los Angeles and Baltimore.

Lime and Cement—Hydrated lime up in New York, Boston, Baltimore and Atlanta; down in St. Louis. Common lump lime cheaper in Boston and Atlanta. Lump finishing, lower in Boston but advanced slightly in Atlanta. Cement prices fairly stable; advances, however, reported in Boston, Atlanta, Los Angeles and Baltimore.

Structural Steel — Steel contract prices advancing. Premiums, however, previously demanded for quick deliveries, are disappearing from the market due to falling off in demand and consequent increase in promptness of shipments. Shapes and plates now $2.50@$2.75; bars, $2.40@$2.75 per 100 lb., f.o.b. Pittsburgh. Less pressure in demand for plates. Mills reluctant to take on additional orders while deliveries are still behind on tonnages already booked.

Brick and Hollow Tile—Brick prices unchanged in New York since first of the year. Common brick up $1 in Atlanta, $1.50 in Dallas, $2 in Boston and $3.80 per M. in Baltimore; down $1 in Kansas City and slightly lower in Detroit. Hollow tile higher in New York, Chicago, St. Louis, Baltimore and Boston; no declines.

Lumber—Yellow pine timbers up $2 per M. ft. in New York, since month ago. Pine lumber also advanced in Minneapolis, Atlanta, Birmingham, Detroit and St. Louis and declined in Boston and Chicago. Douglas fir timbers rose in San Francisco, Boston, Seattle, Denver, Minneapolis and Detroit; no declines reported. Hemlock advanced in Denver; no changes elsewhere either in hemlock or spruce.

Explosives—Dynamite, 40 per cent gelatin, advanced ½c. per lb. in New York, Apr. 2. Similar advances occurred in both 40 and 60 per cent, in Minneapolis, St. Louis, Denver, Baltimore and New Orleans.

Scrap—Prices unchanged in New York; slightly higher in St. Louis despite fact that scrap is more plentiful.

Linseed Oil—Raw oil advanced 3c. in New York and 10c. per gal. in Chicago, during month. Recent advance also reported in Dallas with declines in San Francisco and Montreal.

Hoover Wants Program Before Calling Conference

Secretary of Commerce Hoover will withhold action, for the present at least on the plan for calling a conference of the building and construction industries with a view to stabilizing construction. The following letter from Mr. Hoover, made public by the National Lumber Manufacturers Association, suggests that the trades themselves should formulate some sort of program as a preliminary to any conference that might be called:

"I have received several score of requests that a conference be called in Washington of the building and construction material industries with a view to evolving some sort of plan for orderly construction. I have felt, however, that it would be very difficult for such a conference to arrive at concrete results which did not in some stage appear to be unwarranted restraint on freedom of action in the building trades.

"This department is alive to the necessities of larger construction due to the deficiencies accumulated over many years and I would deplore official action which might have unexpected results. It is vital for the country that our construction industries should proceed in an orderly manner without inflation in prices or costs, as such inflation would inevitably bring about a buyers' strike. I have felt that the Government could contribute something to the situation by withholding its own building programs as far as possible, thus giving a clearer field to private construction. Government construction could be speeded up at such times as there is relaxation in private demand.

"I am at all times only too willing and anxious to cooperate with the trades in these great questions, but before assembling a conference, I feel we should have before us from the trades themselves some sort of program as to what might be accomplished by such a conference. I would be greatly obliged if you could make any suggestions along this line. I have a perfectly open mind in the matter, as indicated above, but I see a great many dangers that might come out of it."

Next Week—See first page of Construction News.

Labor Rates and Conditions Throughout the Country

Production of construction materials and manufactured products is going forward at an unprecedented rate. The heavy demand, which continues, comes not only from the construction industry, but from railroads as well.

With respect to the generally acknowledged labor shortage, the preliminary results of a survey conducted by the National Industrial Conference Board indicated that this is only about 2½ per cent of the total number employed in industry on Mar. 15. Small as this percentage is, its effect has been considerable, and there is the danger of a greater labor shortage.

The common labor rate for the nation as applied to pick and shovel men in construction operations, is placed at 51c. per hr. as against 50c. for the preceding month, according to *Engineering News-Record's* figures. Local building conditions are as follows:

Atlanta—Building brisk; wage schedules unchanged.

Baltimore—Scarcity of bricklayers, carpenters, hodcarriers, structural iron workers and common laborers.

Birmingham—Wage rates unchanged except common labor, which advanced slightly.

Boston—Scarcity of pile drivers, plenty of other trades. Wage schedule advanced.

Chicago — Landis Award Board granted carpenters, caisson workers and common laborers wage advance, effective June 1.

Dallas—Bricklayers and carpenters practically 100 per cent employed. Bricklayers union scale advanced $1 per day, effective May 15. Small surplus of hoisting engineers, hodcarriers, piledrivers and structural ironworkers. Common labor situation improving.

Denver—Shortage of bricklayers; surplus of carpenters. General advance in wage schedules.

Detroit—No change in building employers' scales for any trade. Tendency to pay bonuses. No scarcity reported but men in all trades in good demand.

Kansas City—Bonuses of $2 per day offered bricklayers. Scarcity of carpenters and hodcarriers.

New York—Employers in building trades disposed to grant increases of $1 to $2 per day to various crafts in form of bonuses, thereby averting threatened strike of May 1. Most serious problem involves interjurisdictional dispute between several unions of Building Trades Council over right to cut concrete for piping and wiring. About 2,700 stone workers struck for $2 per day increase, Apr. 20. Plasterers union on trial charged with restraint of trade and commerce.

Philadelphia—Fair supply of hoisting engineers and piledrivers; no surplus in any other trade.

St. Louis—Shortage of bricklayers; paying as high as $13@$15 per day. Carpenters advanced from $1.10 to $1.25 per hr., effective May 1. Hoisting engineers and piledrivers get increases of 12½c. and 25c. per hr., respectively, effective May 1. Bonus of $1 per day granted structural ironworkers.

Seattle—Carpenters, structural ironworkers, piledrivers and hoisting engineers granted increases of $1 per day. House painters and glaziers receive advance of 50c. per day.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	+1.50	+1.00	.80@1.00	.87½	$0.65	.80@1.00	+.30@.50
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	+.20@.30
Boston	1.25	+1.12½	+1.00@1.25	+.82½	1.00	+1.12½	+.60@.70
Cincinnati	1.25	1.00	1.00	.77½	1.00	1.00	.40@.60
Chicago	1.10	+1.15	1.10	.....	1.10	1.05	.72½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.25	.87½
Dallas	+1.37½@1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	+1.37½@1.50	+1.12½	+1.12½@1.18¾	.75@.81¼	1.00	+1.15¾	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	1.00@1.25	+.75	1.00	1.00	.35@.50
Los Angeles	1.25	1.00	1.00	+.62½	.....	+1.00	.50
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.90	.65	.50	30	.50	.65	.25
New Orleans	1.00	.85	.90	.65	.80	1.00	35@.40
New York	+1.50	1.12½	+1.25@1.50	+1.00	1.00	1.12½	+.50@.75
Pittsburgh	1.30	1.20	1.12½	.90	.....	1.00	.50
St. Louis	1.50	+1.25	+1.25@1.37½	1.00	+1.25	1.25	+.45@.90
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.56¼
Seattle	1.12½	+1.00	1.00	93¾	1.00	+1.12½	+.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

Price advances since last month are indicated by heavy type; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	May 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$31.55	$20.50
Northern Basic	32.27	20.78
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	33.27	20.50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	34.44	26.16
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.00	16.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*32.64*	22.34
Virginia No. 2 (silicon 2.25 @ 2.75)	34.17	28.24
Basic	**31.50**	20.25
Gray Forge	**31.50**	21.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**33.00**	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	33.01	16.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**32.00**	21.96
Basic	31.00	21.46
Bessemer	31.00	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	May 3	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	**45.00**	30.00	2.00*	43.00	43@45
Light rails, 12 to 14 lb.	**45.00**	30.00	2.00*	43.00	43@45
Light rails, 25 to 45 lb.	**45.00**	30.00	2.00*	43.00	43@45
Rerolled Rails	**45.00**	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	**1.20**	**1.45**
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	May 3	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.15	$2.15@2.25	$3.00	$4.15	$4.85	$3.60
Track bolts	4.00 @4.50	3.00@3.50	4.00	5.15	5.85	4.60
Standard section angle bars	2.75	2.40	2.75	4.00	4.10	3.00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	¼ to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½ to 4	26	11
7 to 8	56	43½	4½ to 6	28	13
9 to 12	54	41½	7 to 12	26	11

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	¼ to 1¼	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 to 8	52	39½	7 to 8	21	7
9 and 10	45	32½	6 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	52%	62½%	52%
2½ to 6 in. lap welded	49%	59½%	49%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	39%	48½%	39%
2½ to 6 in. lap welded	36%	45½%	36%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 10%. Cast iron, standard sizes, 21½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	New York				San
	Mill	May 3	One Year Ago	Chicago	St. Louis	Francisco
4 in.	**$53.00**	**$63.00**	$50.80@51.80	**$62.20**	**$61.60**	$64.06
6 in. and over	**49.00**	**58.50**	46.80@47.80	**58.20**	**57.50**	60.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	May 3	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	*$40.00*	$62.50	.....	$73.00
4	55.00	50.00	*40.00*	75.00	$76.50	83.00
5	80.00	80.00	.....	100.00	97.75	108.00
6	105.00	100.00	*75.00*	175.00	127.50	133.00
8	170.00	150.00	*185.00*	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.114	.....	.....	$0.15	$0.12	.....
4	.....	.114	$0.10	*$0.10*	.15	.15	$0.12
5	.....	.171	.125	.....	.23	.18	.16
6	$0.24	.171	.150	*.14*	.23	.21	.1855
8	.38	.266	.25	*.225*	.35	.30	.30
10	.57	.399	.325	*.315*	.53	.42	.441
12	.72	.513	.425	*.405*	.68	.54	.567
15	1.13†	.684	.625	*.675*†	.90	.90	.819
18	1.65†	.95	.85	*.945*†	1.25	1.32	1.071
20	1.98†	1.14	1.125	.....	1.50	.....	.....
22	2.64†	1.52	1.375	*1.26*†	2.00	.....	1.44
24	2.97†	1.71	1.625	*1.62*†	2.25	2.16	1.89
27	4.81†	2.99	....	*2.65*†	4.69†	3.00	3.34
30	5.33†	3.312	....	*3.25*†	5.94†	3.60	4.06
33	6.93†	4.41	....	*3.95*†	6.88†	.....	4.99
36	7.91†	5.0225	....	*4.30*†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	**$0.127**	**$0.195**	**$0.308**	**$0.595**	**$1.975**	**†$5.90†**
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72†	2.60†	.....
Los Angeles	.11	.165	.275	.495	1.65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.14	.215	.34	.66	2.25	4.92†
Atlanta	.112*	.168*	.28	.476	1.82	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	**.126**	**.189**	**.294**	**.567**	**1.89**	**5.4375**
Kansas City, Mo.	.135*	.19*	.30*	.52	2.09	3.95
Philadelphia	.124	.1871	.286	.545	1.89†	4.37†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		May 3	One Year Ago
New York, 45% asphalt	(at terminal)	**$0.0525**	$0.05
New York, 65% asphalt	(at terminal)	**.0525**	.045
New York, binder	(at terminal)	**.06**	.055
New York, flux	(at terminal)	**.0575**	.05
New York, liquid asphalt	(at terminal)	**.06**	.06
St. Louis, 50@60% asphalt		*.058*	.05
St. Louis, 40@50% asphalt		*.051*	.05
Chicago, 40–50% asphalt		.0525	.05
Chicago, 60–70% asphalt		.055	.0525
Dallas, 45% asphalt		.04	.10
Dallas, 55% asphalt		.048	.13
Dallas, binder		.053	.15
San Francisco, binder, per ton		9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19.00	$15.00
Boston (*Mexican*)	21.00	17.00
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	23.00	15.00
Seattle, "*D*" *grade* (*California*)	24.75	20.50†
Denver (*California*)	24.00	.....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.45	19.10
St. Louis (*Mexican*)	30.00	25.00
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23.50
Detroit (*Mexican*)	22.47	18.40
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	21.00	18.00
Kansas City (*Texas*)	27.50	25.50
Los Angeles "*D*" *grade* (*California*)	19.15	11.00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	2.50 per sq.yd.
	About 4x8x4 common	3.10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite, 28 blocks per sq.yd.	$130.00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
	4-in. Granite	3.25 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed	3.10 per sq.yd.
	4x8x4 common	2.90 per sq.yd.
Kansas City	Granite	3.25 per sq.yd.
Philadelphia	Granite	134.50 per M.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide	per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in. $1.40 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.63
New York (*delivered*)	3½	16	3.19
Boston	3½	16	2.50
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.75
St. Louis	4	16	3.10
Seattle	4	16	Off market
Minneapolis	3½	16	2.62
Atlanta	3½	16	2.00
New Orleans	3	16	2.45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	3.65
Philadelphia	3½	16	2.60

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. May 3	Gravel 1½ In. One Year Ago	Gravel ¾ In. May 3	Gravel ¾ In. One Year Ago	Sand May 3	Sand One Year Ago
New York	$2.25	$1.75	$2.25	$1.75	$1.75	$1.00
Denver	1.90	2.50	1.90	2.50	1.00	1.10
Chicago	2.00	1.80	2.00	1.80	2.00	1.80
St. Louis	2.35†	1.25†	2.45	1.30†	2.10†	1.10†
Seattle	1.25	1.50	1.25	1.50	1.25	1.50
Dallas	2.25	2.25	2.25	2.25	1.90	2.25
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	1.00*
Cincinnati	1.50†	1.87½	1.50†	1.87½	1.25†	1.43
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.50†	2.40	1.50†	2.40	1.20†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.25	1.35
Los Angeles	0.75*	1.50†	0.85*	1.50†	1.10†	1.35†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.24†	1.15†
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.45†	1.25†
Philadelphia	1.85	1.50	1.95	1.55	1.90	1.60
Kansas City	1.60	2.00	1.60	2.00	0.66*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. May 3	1½ In. One Year Ago	¾ In. May 3	¾ In. One Year Ago
New York	$1.65	$1.65	$1.75	$1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis *delivered*	2.10	1.65	2.30	1.65
Dallas	2.50	2.73	2.50	2.73
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.75*	3.00*	1.75*	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2.00*	1.90*
Cincinnati	1.75*	1.75	2.25*	1.75
Los Angeles	1.60	1.75*	1.60	1.85*
Detroit	1.60@1.90*	1.90*	1.60@1.90*	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	2.00*	1.90*	2.00*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Philadelphia	1.80*	1.70*	1.65*	1.55*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala.	1.00	1.00	1.00	1.00
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.60	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.60	1.50†	1.50†
St. Louis	23.00	19.00	.....	.....
Boston	22.00	15.00	4.00*	2.85*
Dallas	22.50	.....	.....	2.50†
Cincinnati	16.80	13.30	.....	10.75‡
San Francisco	22.00	16.00	.....	1.75†
Minneapolis	25.50	21.00 (white)	1.60†	1.25†
Denver	24.00	.....	.....	2.70†
Detroit	19.50	17.50	.....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	.....	3.00*
Baltimore	24.25	17.25	2.55	.....
Montreal	21.00	21.00	.....	11.00‡
Atlanta	23.50	15.00	2.35†	1.50†
New Orleans	.....	.....	2.40†	.....
Philadelphia	16.00	15.00	13.50‡	12.50‡
Kansas City	25.60	24.00	.....	2.40*

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.60. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	May 3	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2.60	0.80 per bag
St. Louis (Carney)	1.75	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	May 3	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.40
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	2.80	2.75	2.50
Chicago	2.20	2.20	1.97
Pittsburgh	2.24	2.24	2.02
Cleveland	2.46	2.46	2.26
Detroit	2.47	2.47	2.17
Indianapolis	2.41	2.41	2.21
Toledo	2.48	2.48	2.20
Milwaukee	2.37	2.37	2.18
Duluth	2.14	2.14	1.94
Peoria	2.41	2.41	2.08
Cedar Rapids	2.48	2.48	2.21
Davenport	2.43	2.43	2.16
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.73
New Orleans	3.30	3.30	3.00
Minneapolis	2.39	2.39	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.25
Atlanta	3.50	2.90	2.39
Cincinnati	2.54	2.54	2.35
Los Angeles	3.80	3.40	3.30
Baltimore	3.05	2.61	2.50
Birmingham	2.50	2.50	2.27
Kansas City	2.42	2.42	2.40
Montreal (*delivered*)	2.68	2.88	2.50
Philadelphia	2.41	2.41	2.21
St. Paul	2.39	2.39	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	La Salle, Ill.	$2.10
Universal, Pa.	2.00	Hudson, N. Y.	2.20
Steelton, Minn.	1.95	Leeds, Ala.	2.20
Fordwick, Va.	2.20	Hannibal, Mo.	2.10
Mitchell, Ind.	2.10	Lehigh Valley District	2.30
Iola, Kan.	2.10	Wyandotte, Mich.	2.10
[illegible]son City, Ia.	2.10	Alpena, Mich.	

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse New York	Warehouse St. Louis	Warehouse Dallas	Warehouse San Francisco
032	22	**$0 92**	$0 99	**$1.24**	**$1 02**	**$1.09**	**$1 12**
049	28	**1 18**	1.28	1.58	**1.30**	1.33	**1 45**
068	35	**1 44**	1 56	1 94	**1 59**	1 61	**1 77**
093	45	**1 85**	2 00	2.50	**2 04**	1 935	**2 28**
126	57	**2 28**	2 47	3 09	**2 53**	2 451	**2.81**
153	68	**2 72**	2.95	3.60	**3 01**	3 05	.....
180	78	**3 12**	3.39	4.22	**3.46**	3 351	.....
245	103	**4 12**	4 47	5.60	**4.56**	4 427	.....
287	119	**4.76**	5 16	6.44	**5.27**	5 115	**5 68**
336	138	**5 52**	5.99	7.39	**6.11**	5 934	.....
395	160	**6.40**	6.94	8.67	**7.09**	6.88	.....
		PAVING					
036P	17	**$0.71**	$0 77	$0.95	**$0 78**	$0.731	.....
053P	24	**1.00**	1 08	1.35	**1.10**	1 032	.....
072P	31	**1.26**	1.37	1 71	**1.39**	1 333	.....
097P	40	**1.62**	1 76	2.20	**1.79**	1 84	.....
049R	24	.....	1 08	....	**1.10**	1 032	.....
067R	31	.....	1.37	....	**1 39**	1 333	.....
089R	40	....	1.76	....	**1.79**	1 84	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	**$21 25**	$20.72	$21 43	$25 50
26 "	2.5	22.00	**22 50**	22 39	20 78	27 58
25 "	3.0	22 00	**25 25**	24.93	.....	30 71
24 "	3.4	24.00	**27 25**	27.10	24 28	33 16
22 "	4.33	27 00	**31 75**	32.27	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	**$2 40@2.75**	**$2 65**	$3 34	**$3 32½**	**$3.35**	$3 15	$3 40
⅝	**2 45@2.80**	**2.75**	3 39	**3.37½**	**3.40**	3 20	3.45
¾	**2 50@2.85**	**2.85**	3 44	**3.42½**	**3 45**	3 25	3 50
⅞	**2 65@3.00**	**2 90**	3 49	**3.57½**	**3 60**	3 40	3 65
1	**2 90@3.35**	**2.95**	3.84	**3.82½**	**3 80**	3.65	3.90

Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	*2.30*	**$3.05**	$2 85	½	*$2.55*	**$3 30**	$3 10
⅝ in	*2.35*	**3.10**	2 90	¾	*2.80*	**3 50**	3.35
1	*2.40*	**3.15**	2.95	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common May 3	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.).....	$23.50	$23.50	$20.40	**$46.50**	**$54.00**
New York (at dock)...	20.00	20.00	17.00	.....	.....
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon.....	15@17	**15@17**	14 00	*36.50*@38.50	40@**42.85**
Denver, salmon.....	12 00	12.00	12 00	.....	.....
Dallas.....	**13.10**	11.60	11 15	33.00	.....
San Francisco.....	15.00	15.00	15 00	.....	.....
Los Angeles (del.).....	15 00	15 00	15 00	(not used)	
Boston.....	**22.00**	20.00	16.00	48.25	56.00
Minneapolis (del.).....	17@19	17@19	15.00	.....	.....
Kansas City.....	*15.50*	16.50	14 50	.....	.....
Seattle.....	13.00	13.00	14 00	50.00	.....
Cincinnati	18.00	18.00	15.00	43 00	43.00
Montreal	16.50	16.50	16 00	100.00‡	68.00
Detroit (del.).....	*17.50*@20.00	20.00	16.50	38.50	41.50
Baltimore (del.).....	**23.00**	19.20	20.00	40.00	45.00
Atlanta.....	**14.00**	13.00	9.00	**42.00**	.....
New Orleans.....	17.25	17.25	12.50	.....	.....
Birmingham.....	12.50	12.50	9.50	.....	.....
Philadelphia.....	19@25	19@25	16.00	40.00	48.00
Pittsburgh (del.).....	16.00	16.00	17.50	.....	.....
Cleveland.....	16.00	16.00	.....	.....	.....

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York May 3 on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12..	**$0 1573**	$0.1112	**$0.1032**	$0.125	$0.09	**$0.108**	.....
6x12x12...	**.2097**	.1667	**.1496**	.....	**.12**	.156	.....
8x12x12...	**.2621**	.2084	**.1754**	.19	**.165**	.244	**$0.2691**
10x12x12...	.....	.....	**.2190**	.....	**.190**	.....	**.3505**
12x12x12...	.....	.....	**.2846**	.....	**.236**	.....	**.4206**

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	**$0.115**	**$0.22**	
Minneapolis (f.o.b. cars).....	.736	.12125	$0.214
Minneapolis (delivered).....	.0836	1369	.239
Cincinnati.....	.0859	.1611	....
Kansas City.....	.083	.1455	.....
Denver.....	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory.....	.10	.175	....
New Orleans.....	.12	.23	.....
Detroit (delivered).....	.101	.1895	.27
Montreal.....	.115	.225	.30
Baltimore.....	**.125**	**.27**	.....
Atlanta.....	.0893	.1674	.....
Dallas.....	.115	....	.....
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.09	.172	.....

San Francisco, Philadelphia, Atlanta and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in....	**$2 50**@2 75	**$2 75**	**$3 44**	**$4 50**	**$3 45**	**$3 40**	**$3 85**
Channels, 3 to 15 in....	**2 50**@2 75	**2 75**	3 44	4 50	**3 45**	**3 40**	**3 85**
Angles, 3 to 16 in., ¼ in. thick.....	**2 50**@2 75	**2 75**	3 44	4 50	**3.45**	**3 40**	**3 85**
Tees, 3 in. and larger...	**2.50**@2.75	**2 75**	3 44	4.50	**3.45**	**3.40**	**3 85**
Plates, ¼ in. thick and heavier.....	**2.50**@2.75	**2.75**	3.44	4.60	**3 45**	**3.40**	**3.85**

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse New York May 3	Warehouse New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger.	**$3.25**@3.50	**$4.00**	$3.50	**$3.75**	**$4.15**	**$5.00**	*$4.95*
CONE HEAD BOILER							
½ in. and larger.	**$3.35**@3.60	**$4.10**	$3 60	**$3.85**	**$4.25**	**$5.10**	*$5.05*
⅝ and ¾.....	**3.50**@3.75	**4.26**	3.76	**4 00**	**4.40**	**5 25**	*5.20*
⅞ and 1.....	**3.75**@4 00	**4.50**	4 00	**4 25**	**4 50**	**5.50**	*5.45*

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	**$2.90@3.10**	**$3 45**	**$4.20**	**$4.25**	**$3.34**	$4 95
Cut.....	....	5.50	5.80	5.75	**3.74**	5 00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., **$6.35**.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb.....	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	38.75
Asphalt felt (light), per ton, f.o.b. plant*.....	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.....	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA", "A" and "B" grades, all at discount of 84 per cent from standard lists, f.o.b. New York.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.65@3.25	**$4.25**	**$4.15**	**$4.85**	**$4.34**
No. 12.....	2.75@3.35	4.30	4.20	**4.90**	4.39
No. 14.....	2.85@3.45	4.35	4.25	**4.95**	4.44
No. 16.....	3.05@3.65	4.45	4.35	**5.00**	4.54
Black					
*Nos. 18 and 20.....	3.35@**3.85**	4.80	4.85	**5.95**	**4 70**
*Nos. 22 and 24.....	3.40@**3.90**	4.85	4.85	**6 00**	**4 75**
*No. 26.....	3.45@**3.95**	4.90	4.90	**6 05**	**4.80**
*No. 28.....	3.50@**4.00**	5.00	5.00	**6.15**	**4.90**
Galvanized					
No. 10.....	4.00@**4.50**	**5.10**	**5 10**	**6.00**	4.90
No. 12.....	4.10@**4.60**	**5.20**	**5 20**	**6.10**	5.00
No. 14.....	4.10@**4.60**	**5.20**	**5 20**	**6.10**	5.00
Nos. 17 to 21.....	4.40@**4.90**	**5.50**		**6.40**	5.30
Nos. 22 and 24.....	4.55@**5.05**	**5.65**	**5.65**	**6.55**	5.45
*Nos. 25 and 26.....	4.70@**5.20**	**5.80**	**5.80**	**6.70**	5.60
*No. 28.....	5.00@**5.50**	**6.10**	**6.10**	**7.00**	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages: for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York May 3	New York One Year Ago	Chicago May 3	Chicago One Year Ago
Raw in barrels (5 bbl. lots).....	**$1.16**	**$0.91**	**$1.25**	**$0.90**

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	May 3		1 Year Ago		May 3	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14.50	16.00	12.25	13.75	14.50	12.25
25 and 50-lb. kegs	14.75	16.25	12.50	14.00	14.75	12.50
12½-lb. keg	15.00	16.50	12.75	14.25	15.00	12.75
5-lb. cans	17.50	19.00	15.25	16.75	17.50	15.25
1-lb. cans	19.50	21.00	17.25	18.75	19.50	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42.00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42.00	42.00	44.00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44.00	$46.00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$52.00	$53.00	$54.00	$56.00
3x10 to 10x10	56.00	57.00	57.00	59.00
3x12 to 12x12	60.00	61.00	60.00	62.00
3x14 to 14x14	67.00	68.00	65.00	67.00
3x16 to 16x16	72.00	73.00	70.00	72.00
3x18 to 18x18	86.00	87.00	82.00	83.00
4x20 to 20x20	96.00	97.00	93.00	95.00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$65.00	$130.00	$65.00	$65.00	$95.00	$150.00
Seattle	.....	31.00	.....	.....	.....	31.00
New Orleans	35.00	.....	.....	.....	40.00	.....
Baltimore	35.00	53.00	53.00	60.00	50.00	53.00
Cincinnati	45.00	51.50	51.50	51.50	45.00	53.50
Montreal	50.00	.....	.....	.....	.....	90.00
Los Angeles	.....	53.00	.....	.....	.....	54.00
Denver	.....	43.00	43.00	43.00	.....	44.00
Minneapolis	46.50	45.75	41.50	.....	50.00	46.75
Atlanta	38.00	.....	.....	.....	42.00	.....
Dallas	48.00	.....	.....	.....	53.00	.....
Kansas City	45.75	44.75	44.75	.....	58.75	48.75
Birmingham	38.00	.....	.....	.....	45.00	.....
Philadelphia	47.00	41.50	40.00	45.00	58.00	42.00
Detroit	48.75	53.25	.....	.....	61.75	53.25
St. Louis	46.00	.....	.....	.....	53.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$90.00	$50.00	$57.00	$105.00
Seattle	.....	28.00	.....	.....	30.00
New Orleans, at mill	80.00	.....	.....	39.00	.....
Baltimore	65.00	44.00	44.00	37.00	50.00
Cincinnati	60.00	82.00	82.00	35.00	78.00
Montreal	.....	50.00	37.00	45.00	45.00
Los Angeles	.....	48.00	.....	.....	.....
Denver	.....	.....	38.25	38.25	37.25
Minneapolis	47.50	43.25	39.50	43.75	41.25
Atlanta	22.00	.....	.....	32.00	.....
Dallas	48.00	.....	.....	51.50	.....
Kansas City	81.00	.....	.....	69.00	.....
Birmingham	32.00	.....	.....	42.00	.....
Philadelphia	37.00	43.00	40.00	57.00	41.50
Detroit	55.25	42.00	.....	48.50	43.00
St. Louis	47.50	.....	.....	37.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.36§	New Orleans	.515
Buffalo	.26	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.29	Philadelphia	.32
Cleveland	.21	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

May 3	One Month Ago	One Year Ago
$2.60@2.75	$2.30@2.70	$2.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	22½%
Patent flattened strand, special and cast steel	22½%
Patent flattened strand, iron rope	7½%
Plow steel round strand rope	37½%
Special steel round strand rope	32½%
Cast steel round strand rope	25%
Round strand iron and iron tiller	7½%
Galvanized steel rigging and guy rope	10%
Galvanized iron rigging and guy rope	+10%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅛-in., 8 ft.; ¼-in., 6; ⅜-in., 4½; ½-in., 3½; ⅝-in., 2 ft. 10 in.; ¾-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.16½	New Orleans	$0.18½
New York	.18½	Los Angeles	.....
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.30
Atlanta	.22	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.20	Kansas City	.20½
Dallas	.129	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.275	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.1967	.2175
St. Louis	.2275	.2525
Denver	.2075	.2325
Dallas	.29	.375
Los Angeles	.....	.....
Atlanta	.23	.26
Baltimore	.22	.23
Cincinnati	.22	.25
Montreal	.195¶	.235
Birmingham, *delivered*	.16	.17
New Orleans	.252	.285
San Francisco	.1625	.1925
Philadelphia	.2625	.295

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$21.00	$11.50	$17.25
Stove plate	17.00	12.00	17.00
No. 1 machinery cast	21.00	16.50	21.25
Machine shop turnings	14.00	4.00	13.00
Cast borings	15.00	5.50	14.00
Railroad malleable cast	20.00	12.50	22.50
Re-rolling rails	21.00	13.00	21.75
Relaying rails	28.50	30.00	29.25@31.50
Heavy melting steel	18.50@19.00	.....	.....

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
	$8.25	$6.25	$8.00
	7.30	5.80	7.25
	7.15	5.65	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3.75.

Engineering

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N

Downstream Face of
Multiple-Arch Struc